

Operation

Residential/Commercial Generator Sets



Models:

14/20RES
14/20RESL

Controller:

RDC Residential Digital Control
DC Digital Control

KOHLER
POWER SYSTEMS

9001
KOHLER
POWER SYSTEMS
NATIONALLY REGISTERED

TP-6734 5/10

California Proposition 65

** WARNING**

Engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

Product Identification Information

Product identification numbers determine service parts. Record the product identification numbers in the spaces below immediately after unpacking the products so that the numbers are readily available for future reference. Record field-installed kit numbers after installing the kits.

Generator Set Identification Numbers

Record the product identification numbers from the generator set nameplate(s).

Model Designation _____

Specification Number _____

Serial Number _____

Accessory Number	Accessory Description
------------------	-----------------------

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
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_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Controller Identification

Record the controller description from the generator set operation manual, spec sheet, or sales invoice.

Controller Description _____

Engine Identification

Record the product identification information from the engine nameplate.

Manufacturer _____

Model Designation _____

Serial Number _____

Table of Contents

Product Identification Information	2
Safety Precautions and Instructions	5
Introduction	9
Service Assistance	11
Section 1 Descriptions and Service Views	13
1.1 Introduction	13
1.2 Engine	13
1.3 Alternator	13
1.4 Transfer Switch	13
1.5 Controllers	14
1.6 Accessories	15
1.6.1 Carburetor heater	15
1.6.2 OnCuet Home Generator Management System	15
1.7 Service Views for Maintenance	16
Section 2 Operation	17
2.1 Prestart Checklist	17
2.2 Exercising the Generator Set	17
2.3 RDC and DC Generator Set/ Transfer Switch Controllers	17
2.4 Controller Power	17
2.5 Controls and Indicators	18
2.5.1 LED Display	19
2.5.2 Controller Keypad	19
2.5.3 LED Indicators	20
2.6 Generator Set Operation	21
2.6.1 Engine Start Crank Cycle	21
2.6.2 Local Starting and Stopping	21
2.6.3 Automatic Operation with Model RRT Transfer Switch	21
2.6.4 Automatic Operation with Model RDT or RSB Transfer Switches	21
2.7 Exercise	22
2.7.1 Unloaded Exercise with Diagnostic Test	22
2.7.2 Low-Speed Diagnostics	22
2.7.3 Loaded Exercise	22
2.7.4 Exerciser Reset and Disable	23
2.7.5 Power Failure During Exercise Cycle	23
2.8 Test	23
2.8.1 Unloaded Test	23
2.8.2 Loaded Test	23
2.8.3 Power Failure During Test Cycle	24
2.9 Faults	24
2.9.1 Warnings	24
2.9.2 Shutdowns	24
2.9.3 ATS Communication Errors	24
2.9.4 Resetting the Controller after a Fault Shutdown	24
2.10 Model RRT Transfer Switch Operation	27
2.10.1 Source Availability	27
2.10.2 ATS Control Sequence of Operation	27
2.10.3 Time Delays	27
2.10.4 Engine and Transfer Time Delays	28
2.10.5 Load Control Time Delay	28
2.11 Event History	28

Table of Contents, continued

Section 3 Scheduled Maintenance	29
3.1 Scheduled Maintenance	29
3.1.1 Service Schedule, 14RES/RESL Models	30
3.1.2 Service Schedule, 20RES/RESL Models	31
3.2 Lubrication System	32
3.2.1 Low Oil Pressure Shutdown	32
3.2.2 Oil Check	32
3.2.3 Engine Oil Recommendation	32
3.2.4 Oil Change Procedure	32
3.2.5 Oil Cooler 20RES/RESL	33
3.3 Spark Plugs	34
3.4 Air Cleaner Service	34
3.4.1 Air Cleaner, 14RES/RESL Models	34
3.4.2 Air Cleaner, 20RES/RESL Models	35
3.5 Cooling System	36
3.6 Exhaust System	36
3.7 Battery	37
3.8 Battery Charger	38
3.8.1 RES Battery Charger	38
3.9 Circuit Protection	39
3.9.1 Line Circuit Breaker	39
3.9.2 Fuses	39
3.10 Storage Procedure	40
3.10.1 Lubricating System	40
3.10.2 Fuel System	40
3.10.3 Cylinder Lubrication	40
3.10.4 Exterior Preparation	40
3.10.5 Battery	40
Section 4 Troubleshooting	41
4.1 Introduction	41
4.2 Controller Service Access	41
4.3 Generator Set Troubleshooting	41
4.4 Battery Charger Troubleshooting	43
Appendix A Abbreviations	45

Safety Precautions and Instructions

IMPORTANT SAFETY INSTRUCTIONS. Electromechanical equipment, including generator sets, transfer switches, switchgear, and accessories, can cause bodily harm and pose life-threatening danger when improperly installed, operated, or maintained. To prevent accidents be aware of potential dangers and act safely. Read and follow all safety precautions and instructions. **SAVE THESE INSTRUCTIONS.**

This manual has several types of safety precautions and instructions: Danger, Warning, Caution, and Notice.

DANGER

Danger indicates the presence of a hazard that **will cause severe personal injury, death, or substantial property damage.**

WARNING

Warning indicates the presence of a hazard that **can cause severe personal injury, death, or substantial property damage.**

CAUTION

Caution indicates the presence of a hazard that **will or can cause minor personal injury or property damage.**

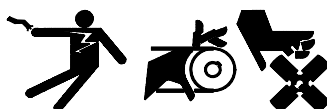
NOTICE

Notice communicates installation, operation, or maintenance information that is safety related but not hazard related.

Safety decals affixed to the equipment in prominent places alert the operator or service technician to potential hazards and explain how to act safely. The decals are shown throughout this publication to improve operator recognition. Replace missing or damaged decals.

Accidental Starting

WARNING



Accidental starting.
Can cause severe injury or death.

Disconnect the battery cables before working on the generator set. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery.

Disabling the generator set. Accidental starting can cause severe injury or death. Before working on the generator set or connected equipment, disable the generator set as follows: (1) Move the generator set master switch to the OFF position. (2) Disconnect the power to the battery charger. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent starting of the generator set by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer.

Battery

WARNING



Sulfuric acid in batteries.
Can cause severe injury or death.

Wear protective goggles and clothing. Battery acid may cause blindness and burn skin.

WARNING



Explosion.
Can cause severe injury or death.
Relays in the battery charger cause arcs or sparks.

Locate the battery in a well-ventilated area. Isolate the battery charger from explosive fumes.

Battery electrolyte is a diluted sulfuric acid. Battery acid can cause severe injury or death. Battery acid can cause blindness and burn skin. Always wear splashproof safety goggles, rubber gloves, and boots when servicing the battery. Do not open a sealed battery or mutilate the battery case. If battery acid splashes in the eyes or on the skin, immediately flush the affected area for 15 minutes with large quantities of clean water. Seek immediate medical aid in the case of eye contact. Never add acid to a battery after placing the battery in service, as this may result in hazardous spattering of battery acid.

Battery acid cleanup. Battery acid can cause severe injury or death. Battery acid is electrically conductive and corrosive. Add 500 g (1 lb.) of bicarbonate of soda (baking soda) to a container with 4 L (1 gal.) of water and mix the neutralizing solution. Pour the neutralizing solution on the spilled battery acid and continue to add the neutralizing solution to the spilled battery acid until all evidence of a chemical reaction (foaming) has ceased. Flush the resulting liquid with water and dry the area.

Battery gases. Explosion can cause severe injury or death. Battery gases can cause an explosion. Do not smoke or permit flames or sparks to occur near a battery at any time, particularly when it is charging. Do not dispose of a battery in a fire. To prevent burns and sparks that could cause an explosion, avoid touching the battery terminals with tools or other metal objects. Remove all jewelry before servicing the equipment. Discharge static electricity from your body before touching batteries by first touching a grounded metal surface away from the battery. To avoid sparks, do not disturb the battery charger connections while the battery is charging. Always turn the battery charger off before disconnecting the battery connections. Ventilate the compartments containing batteries to prevent accumulation of explosive gases.

Battery short circuits. Explosion can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage. Disconnect the battery before generator set installation or maintenance. Remove all jewelry before servicing the equipment. Use tools with insulated handles. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery. Never connect the negative (-) battery cable to the positive (+) connection terminal of the starter solenoid. Do not test the battery condition by shorting the terminals together.

Engine Backfire/Flash Fire

⚠ WARNING

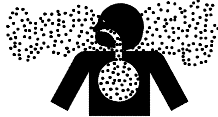
Fire. Can cause severe injury or death. Do not smoke or permit flames or sparks near fuels or the fuel system.

Servicing the air cleaner. A sudden backfire can cause severe injury or death. Do not operate the generator set with the air cleaner removed.

Servicing the fuel system. A flash fire can cause severe injury or death. Do not smoke or permit flames or sparks near the carburetor, fuel line, fuel filter, fuel pump, or other potential sources of spilled fuels or fuel vapors. Catch fuels in an approved container when removing the fuel line or carburetor.

Combustible materials. A fire can cause severe injury or death. Generator set engine fuels and fuel vapors are flammable and explosive. Handle these materials carefully to minimize the risk of fire or explosion. Equip the compartment or nearby area with a fully charged fire extinguisher. Select a fire extinguisher rated ABC or BC for electrical fires or as recommended by the local fire code or an authorized agency. Train all personnel on fire extinguisher operation and fire prevention procedures.

Exhaust System

⚠ WARNING

Carbon monoxide. Can cause severe nausea, fainting, or death. The exhaust system must be leakproof and routinely inspected.

Generator set operation. Carbon monoxide can cause severe nausea, fainting, or death. Carbon monoxide is an odorless, colorless, tasteless, nonirritating gas that can cause death if inhaled for even a short time. Avoid breathing exhaust fumes when working on or near the generator set. Never operate the generator set inside a building. Never operate the generator set where exhaust gas could seep inside or be drawn into a potentially occupied building through windows, air intake vents, or other openings.

Carbon monoxide detectors. Carbon monoxide can cause severe nausea, fainting, or death. Install carbon monoxide detectors on each level of any building adjacent to the generator set. Locate the detectors to adequately warn the building's occupants of the presence of carbon monoxide. Keep the detectors operational at all times. Periodically test and replace the carbon monoxide detectors according to the manufacturer's instructions.

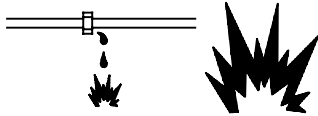
Carbon monoxide symptoms. Carbon monoxide can cause severe nausea, fainting, or death. Carbon monoxide is a poisonous gas present in exhaust gases. Carbon monoxide is an odorless, colorless, tasteless, nonirritating gas that can cause death if inhaled for even a short time. Carbon monoxide poisoning symptoms include but are not limited to the following:

- Light-headedness, dizziness
- Physical fatigue, weakness in joints and muscles
- Sleepiness, mental fatigue, inability to concentrate or speak clearly, blurred vision
- Stomachache, vomiting, nausea

If experiencing any of these symptoms and carbon monoxide poisoning is possible, seek fresh air immediately and remain active. Do not sit, lie down, or fall asleep. Alert others to the possibility of carbon monoxide poisoning. Seek medical attention if the condition of affected persons does not improve within minutes of breathing fresh air.

Fuel System

⚠ WARNING



Explosive fuel vapors.
Can cause severe injury or death.

Use extreme care when handling, storing, and using fuels.

The fuel system. Explosive fuel vapors can cause severe injury or death. Vaporized fuels are highly explosive. Use extreme care when handling and storing fuels. Store fuels in a well-ventilated area away from spark-producing equipment and out of the reach of children. Never add fuel to the tank while the engine is running because spilled fuel may ignite on contact with hot parts or from sparks. Do not smoke or permit flames or sparks to occur near sources of spilled fuel or fuel vapors. Keep the fuel lines and connections tight and in good condition. Do not replace flexible fuel lines with rigid lines. Use flexible sections to avoid fuel line breakage caused by vibration. Do not operate the generator set in the presence of fuel leaks, fuel accumulation, or sparks. Repair fuel systems before resuming generator set operation.

Gas fuel leaks. Explosive fuel vapors can cause severe injury or death. Fuel leakage can cause an explosion. Check the LP vapor gas or natural gas fuel system for leakage by using a soap and water solution with the fuel system test pressurized to 6-8 ounces per square inch (10-14 inches water column). Do not use a soap solution containing either ammonia or chlorine because both prevent bubble formation. A successful test depends on the ability of the solution to bubble.

Hazardous Noise

⚠ CAUTION



Hazardous noise.
Can cause hearing loss.

Never operate the generator set without a muffler or with a faulty exhaust system.

Engine noise. Hazardous noise can cause hearing loss. Generator sets not equipped with sound enclosures can produce noise levels greater than 105 dBA. Prolonged exposure to noise levels greater than 85 dBA can cause permanent hearing loss. Wear hearing protection when near an operating generator set.

Hazardous Voltage/ Moving Parts

⚠ WARNING



Hazardous voltage. Moving parts.
Can cause severe injury or death.

Operate the generator set only when all guards and electrical enclosures are in place.

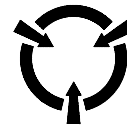
⚠ WARNING



Hazardous voltage.
Backfeed to the utility system can cause property damage, severe injury, or death.

If the generator set is used for standby power, install an automatic transfer switch to prevent inadvertent interconnection of standby and normal sources of supply.

⚠ CAUTION



Welding the generator set.
Can cause severe electrical equipment damage.

Never weld components of the generator set without first disconnecting the battery, controller wiring harness, and engine electronic control module (ECM).

Grounding electrical equipment. Hazardous voltage can cause severe injury or death. Electrocutation is possible whenever electricity is present. Ensure you comply with all applicable codes and standards. Electrically ground the generator set, transfer switch, and related equipment and electrical circuits. Turn off the main circuit breakers of all power sources before servicing the equipment. Never contact electrical leads or appliances when standing in water or on wet ground because these conditions increase the risk of electrocution.

Welding on the generator set. Can cause severe electrical equipment damage. Before welding on the generator set perform the following steps: (1) Remove the battery cables, negative (-) lead first. (2) Disconnect all engine electronic control module (ECM) connectors. (3) Disconnect all generator set controller and voltage regulator circuit board connectors. (4) Disconnect the engine battery-charging alternator connections. (5) Attach the weld ground connection close to the weld location.

Connecting the battery and the battery charger. Hazardous voltage can cause severe injury or death. Reconnect the battery correctly, positive to positive and negative to negative, to avoid electrical shock and damage to the battery charger and battery(ies). Have a qualified electrician install the battery(ies).

Short circuits. Hazardous voltage/current can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage. Do not contact electrical connections with tools or jewelry while making adjustments or repairs. Remove all jewelry before servicing the equipment.

Electrical backfeed to the utility. Hazardous backfeed voltage can cause severe injury or death. Install a transfer switch in standby power installations to prevent the connection of standby and other sources of power. Electrical backfeed into a utility electrical system can cause severe injury or death to utility personnel working on power lines.

Heavy Equipment

⚠ WARNING

Unbalanced weight. Improper lifting can cause severe injury or death and equipment damage. Do not use lifting eyes. Lift the generator set using lifting bars inserted through the lifting holes on the skid.

Hot Parts

⚠ WARNING

Hot engine and exhaust system. Can cause severe injury or death. Do not work on the generator set until it cools.

Servicing the exhaust system. Hot parts can cause severe injury or death. Do not touch hot engine parts. The engine and exhaust system components become extremely hot during operation.

Servicing the engine heater. Hot parts can cause minor personal injury or property damage. Install the heater before connecting it to power. Operating the heater before installation can cause burns and component damage. Disconnect power to the heater and allow it to cool before servicing the heater or nearby parts.

Notice

NOTICE

Canadian installations only. For standby service connect the output of the generator set to a suitably rated transfer switch in accordance with Canadian Electrical Code, Part 1.

This manual provides operation and maintenance instructions for residential/commercial model 14/20RES and RESL generator sets equipped with Residential Digital Control (RDC) or Digital Control (DC) generator set/transfer switch controllers. The RDC and DC controllers control the generator set and the optional Model RRT transfer switch. See Figure 1.

This generator set is approved for use in stationary applications in locations served by a reliable utility power source. Have the generator set installed by an authorized distributor/dealer or service technician. Refer to TP-6733, Installation Manual, for installation instructions.

Information in this publication represents data available at the time of print. Kohler Co. reserves the right to change this publication and the products represented without notice and without any obligation or liability whatsoever.

Read this manual and carefully follow all procedures and safety precautions to ensure proper equipment operation and to avoid bodily injury. Read and follow the Safety Precautions and Instructions section at the beginning of this manual. Keep this manual with the equipment for future reference.

The equipment service requirements are very important to safe and efficient operation. Inspect the parts often and perform required service at the prescribed intervals. Obtain service from an authorized service distributor/dealer to keep equipment in top condition.

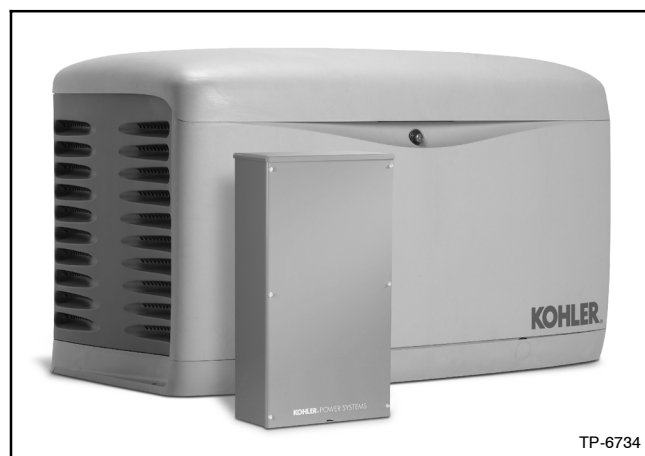


Figure 1 RES/RESL Generator Set and Optional Model RRT Transfer Switch

List of Related Literature

Figure 2 identifies related literature available for the generator sets covered in this manual. Only trained and qualified personnel should install or service the generator set.

Literature Type	Part Number
14/20RES/RESL Generator Set Installation Manual	TP-6733
Model RRT Transfer Switch Operation/Installation Manual	TP-6751

Figure 2 Generator Set Literature

Nameplate

The following illustration shows a typical generator set nameplate. Copy the model, serial, and specification numbers from the nameplate into the spaces provided in the product information section on the inside front cover of this manual. See Section 1.7 for the nameplate location.

KOHLER KOHLER CO. KOHLER WI. USA						
MODEL:			SERIAL:			
SPEC:			BUILD DATE MM/YY			
HZ:		RPM:		FUEL:		
VOLTAGE	AMPS	PHASE	KW	KVA	P.F.	
GEN. MODEL:					BATT. V	
INSUL. NEMA CLASS					40°C AMB.	
KW VARIES WITH BTU CONTENT OF FUEL						
MATL:						GM12070

Emission Compliance, 14RES/RESL

All model 14RES/RESL generator sets with multi-fuel systems are emission-certified.

An engine or generator set with the following identification label is certified to meet Small Off-Road Engine emission standards for EPA/CARB.

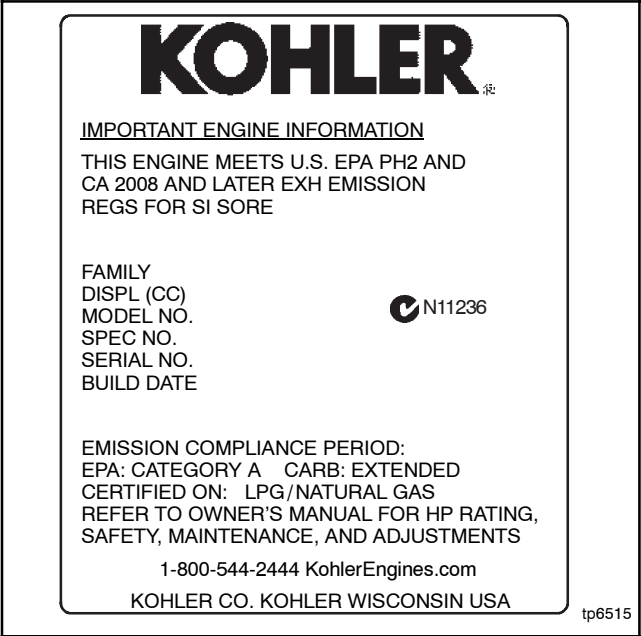


Figure 3 Engine Identification Label, 14RES/RESL Generator Set

This engine/generator is certified to operate using natural gas or propane fuel.

The Emission Compliance Period referred to on the Emission Control or Air Index label indicates the number of operating hours for which the engine has been shown to meet CARB or EPA emission requirements. The following table provides the engine compliance period (in hours) associated with the category descriptor found on the certification label.

Emission Compliance Period (hours)			
EPA	C 250	B 500	A 1000
CARB	Moderate, 125	Intermediate, 250	Extended, 500

Figure 4 14RES/RESL

Refer to the certification label for engine displacement.

The exhaust emission control system for the CH740 engines (14RES/RESL) is EM.

Emission Compliance, 20RES/RESL

The model 20RES/RESL generator set engine is certified to meet emission regulations for U.S. EPA phase 2 small off-road engines and CA 2006 and later LSI engines (large spark-ignited engines at or below 1 liter).

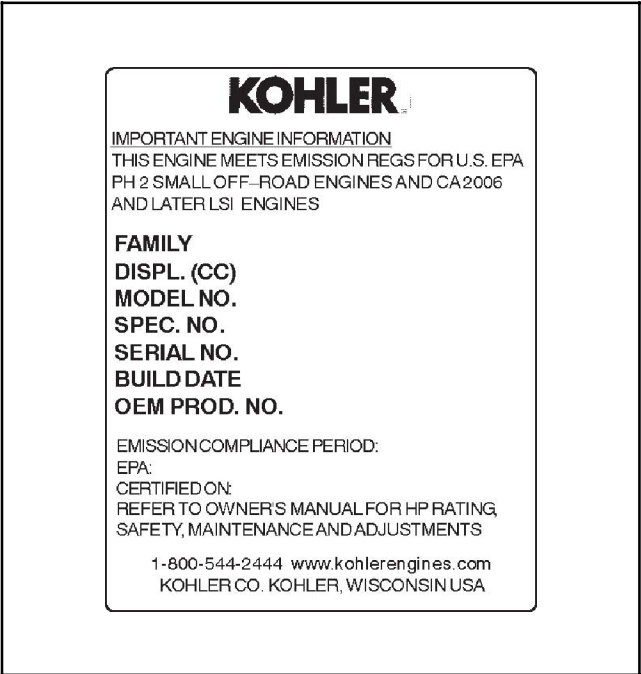


Figure 5 Engine Identification Label, 20RES/RESL Generator Set

The Emission Compliance Period referred to on the Engine Identification label indicates the number of operating hours for which the engine has been shown to meet EPA emission requirements. The engine compliance period (in hours), associated with the Category A descriptor found on the certification label, is 1000 hours.

Emission Compliance Period (hours)	
EPA	Category A, 1000 hours

Figure 6 20RES/RESL

Refer to the certification label for engine displacement.

The exhaust emission control system for the CH1000 engine (20RES/RESL) is EM.

For professional advice on generator set power requirements and conscientious service, please contact your nearest Kohler distributor or dealer.

- Consult the Yellow Pages under the heading Generators—Electric.
- Visit the Kohler Power Systems website at KohlerPower.com.
- Look at the labels and stickers on your Kohler product or review the appropriate literature or documents included with the product.
- Call toll free in the US and Canada 1-800-544-2444.
- Outside the US and Canada, call the nearest regional office.

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India, Bangladesh, Sri Lanka

India Regional Office
Bangalore, India
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(91) 80 3366231
Fax: (91) 80 3315972

Japan, Korea

North Asia Regional Office
Tokyo, Japan
Phone: (813) 3440-4515
Fax: (813) 3440-2727

Latin America

Latin America Regional Office
Lakeland, Florida, USA
Phone: (863) 619-7568
Fax: (863) 701-7131

Notes

Section 1 Descriptions and Service Views

1.1 Introduction

The generator set specification sheets provide specific generator and engine information. Refer to the spec sheet for data not supplied in this manual. Consult the generator set service manual, engine operation manual, and engine service manual for additional specifications. Obtain copies of the latest spec sheets, manuals, diagrams, and drawings from your local distributor/dealer.

1.2 Engine

The generator set has a four-cycle, twin cylinder, air-cooled Kohler® engine. The engine operates on clean-burning natural gas or propane (LP) vapor. Engine features include:

- Efficient overhead valve design and full pressure lubrication for maximum power, torque, and reliability under all operating conditions.
- Dependable, maintenance-free electronic ignition.
- Precision-formulated cast iron construction of parts subjected to the most wear and tear.
- Field-convertible multi-fuel systems that allow fuel changeover from natural gas to LP vapor (and vice-versa) while maintaining CARB emission certification.
- Digital spark advance optimizes ignition timing for the selected fuel.

1.3 Alternator

The generator uses Kohler's unique PowerBoost™ voltage regulation system, which provides instant response to load changes.

PowerBoost™ ensures reliable motor starting and consistent voltage levels. PowerBoost™ utilizes a voltage excitation system that employs a winding independent of the main output windings to provide excitation voltage.

1.4 Transfer Switch

The RDC and DC controllers are designed to communicate with and control the Kohler model RRT Automatic Transfer Switch (ATS).

If the power system uses a transfer switch other than the Kohler® model RRT ATS, the RDC controller functions as a generator set controller only. ATS communication and functions do not operate with any other ATS. The low-speed exercise is not available with any other ATS. An ATS other than the model RRT must provide engine start contacts that connect to the remote engine start leads on the generator set.

1.5 Controllers

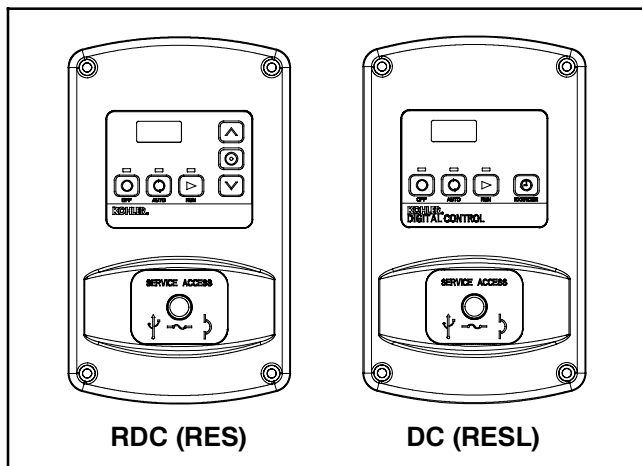


Figure 1-1 Controllers

RES models are equipped with the Residential Digital Control (RDC). RESL models use the Digital Control (DC). See Figure 1-1. Controller features include:

- Integrated control for the generator set and Kohler® Model RRT transfer switch
- Membrane keypad for configuration and adjustment (RDC only)
 - Password-protected access to system configuration and adjustment menus
 - System voltage/frequency selection and engine configuration
 - Voltage, gain, and engine speed adjustment
- Master switch pushbuttons (Off, Auto, Run)
- Off, Auto, and Run LED indicators
- LED display:
 - Crank cycle status
 - Setup information (RDC only)
 - Software version
 - Faults
 - Event history
- Scrolling system status display when generator set is running includes:
 - Engine runtime hours
 - Battery voltage
 - Generator voltage
 - Engine temperature
 - Utility voltage*
- Faults displayed:
 - ATS communication error
- Auxiliary fault
- High battery voltage
- High engine temperature
- Locked rotor
- Low battery voltage
- Low oil pressure
- Overcrank
- Overfrequency
- Overspeed
- Overvoltage
- Underfrequency
- Underspeed
- Undervoltage
- Selectable exercise and test modes:
 - Weekly unloaded quiet diagnostic test *
 - Weekly loaded exercise
 - Loaded test
 - Unloaded test
- Smart engine cooldown senses engine temperature *
- Remote two-wire start/stop capability for optional connection of Model RDT or RSB transfer switches
- Digital isochronous governor to maintain steady-state speed at all loads
- Digital voltage regulation: $\pm 1.5\%$ RMS no-load to full-load
- Automatic start with programmed cranking cycle
- Load control output allows delayed start of large motor loads *
- Field-upgradeable controller firmware (requires Kohler® SiteTech™ software, available only to Kohler authorized distributors and dealers)
- Front-access mini USB connector for software upgrade
- Generator output voltage and frequency sensing with adjustable voltage pickup and dropout settings (requires Kohler® SiteTech™ software for adjustment)
- Engine start and transfer time delays, adjustable using optional Kohler® SiteTech™ software (available only to Kohler authorized distributors and dealers) *
- Communicates utility voltage sensing data and transfer signals with the Model RRT transfer switch *
- Front access fuses and mini-breaker

* Model RRT transfer switch required

1.6 Accessories

The following optional accessories are offered for the RES and RESL generator sets.

1.6.1 Carburetor heater

An optional carburetor heater is recommended for improved cold starting in locations where the ambient temperature drops below 0°C (32°F). The carburetor heater prevents condensation and carburetor icing. The heater requires a continuous source of 120 VAC power.

See the generator set Installation manual for more information.

1.6.2 OnCue™ Home Generator Management System

The Kohler® OnCue™ Home Generator Management System allows monitoring and control of your RES or RESL generator set from a personal computer located in your home or at other remote locations. OnCue™ can also be configured to send email or text message notifications in the event of a generator set fault.

Note: Be sure to obtain the correct version of the OnCue™ kit for the RDC/DC controller.

OnCue™ version 3.0 with the Ethernet option board is required for RES/RESL generator sets equipped with the RDC/DC controller. Earlier versions of the OnCue™ kit are not compatible with the RDC/DC controller.

1.7 Service Views for Maintenance

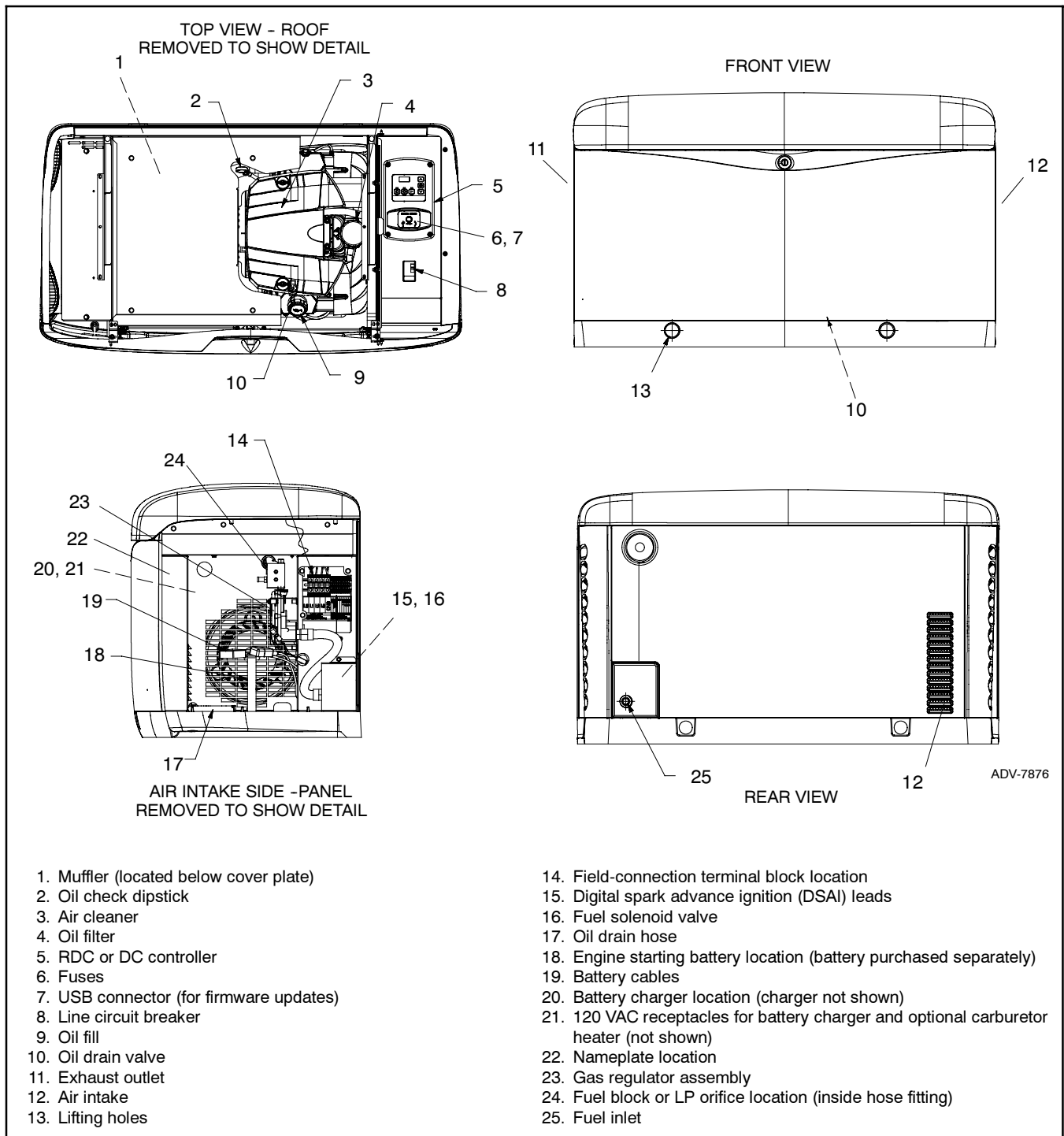


Figure 1-2 Generator Set Components

2.1 Prestart Checklist

To ensure continued satisfactory operation, perform the following checks or inspections before or at each startup, as designated, and at the intervals specified in the service schedule. In addition, some checks require verification after the unit starts.

Air Cleaner. Check for a clean and installed air cleaner element to prevent unfiltered air from entering the engine.

Air Inlets. Check for clean and unobstructed air inlets.

Battery. Check for tight battery connections. Consult the battery manufacturer's instructions regarding battery care and maintenance.

Exhaust System. Check for exhaust leaks and blockages. Check the muffler condition.

- Inspect the exhaust system components for cracks, leaks, and corrosion. Check for tight exhaust system connections.
- Check for corroded or broken metal parts and replace them as needed.
- Check that the exhaust outlet is unobstructed.

Oil Level. Check the oil level before starting the generator set and at the intervals given in Section 3, Scheduled Maintenance. Maintain the oil level at or near, not over, the full mark on the dipstick.

Operating Area. Check for obstructions that could block the flow of cooling air. Keep the air intake area clean. Do not leave rags, tools, or debris on or near the generator set.

2.2 Exercising the Generator Set

Operate the generator set without load once each week for 20 minutes. If the generator set is connected to a Kohler® model RRT transfer switch, a weekly ultra-quiet diagnostic test/exercise can be set to run automatically. See Section 2.7 for instructions to set the exerciser.

If the generator set is connected to a Kohler® model RDT or RSB transfer switch, refer to the transfer switch instructions to set the automatic exercise function. If the generator set is not connected to an automatic transfer switch (ATS) with an exercise option, run the unit in the presence of an operator.

The operator should perform all of the prestart checks before starting the exercise procedure. Start the generator set according to the starting procedure in the controller section of this manual. While the generator set is operating, listen for a smooth-running engine and visually inspect the generator set for fluid or exhaust leaks. Check the air inlets and outlets and remove any items restricting the air flow.

2.3 RDC and DC Generator Set/Transfer Switch Controllers

RES model generator sets are equipped with the Residential Digital Control (RDC). The RDC controls the power system generator set and model RRT automatic transfer switch (ATS) (if equipped). The controller receives voltage sensing data from the ATS and operates the generator set and transfer switch to provide standby power when utility power is lost.

If the generator set is not connected to a Kohler® model RRT ATS, the RDC/DC controller functions as a generator set controller only. ATS communication and functions do not operate with other ATS models. The ultra-quiet diagnostic test/exercise is not available with other ATS models.

2.4 Controller Power

The RDC and DC controllers are powered by the generator set engine starting battery.

Note: The generator sets are equipped with factory-installed battery chargers to prevent battery discharge. The battery charger must be connected to utility power.

2.5 Controls and Indicators

Figure 2-1 illustrates the RDC and DC controller user interfaces.

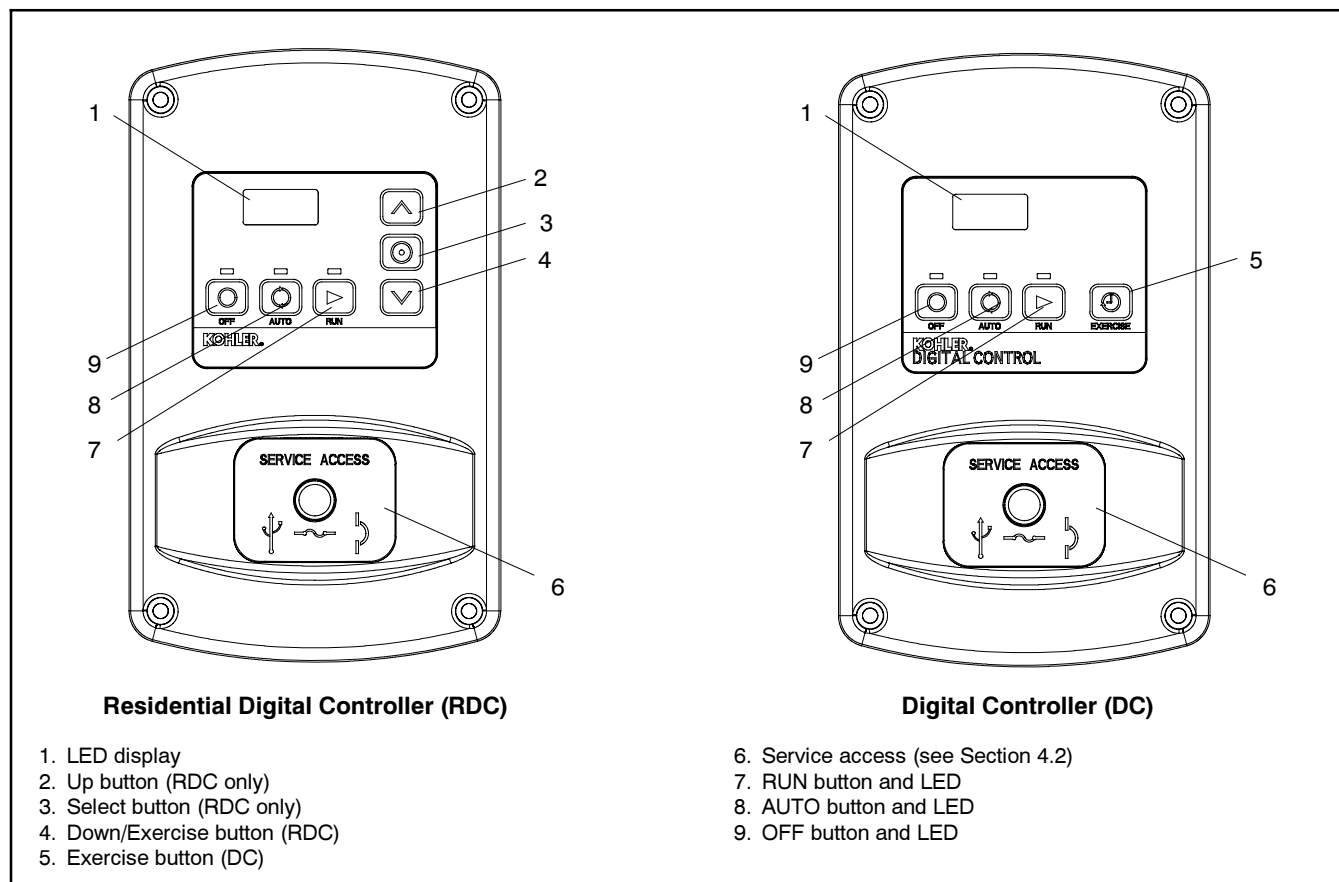


Figure 2-1 RDC and DC Controls and Indicators

2.5.1 LED Display

When the system is in AUTO and the generator set is not running, the LED display shows the engine run time hours. During cranking, the display shows the crank cycle information.

When the generator is running, the display steps through the status messages shown in Figure 2-2, as applicable. The generator set must be connected to a model RRT transfer switch for the utility voltage display.

When a fault or warning condition exists, the controller will show the respective message. The following table shows the various generator conditions and expected display or messages.

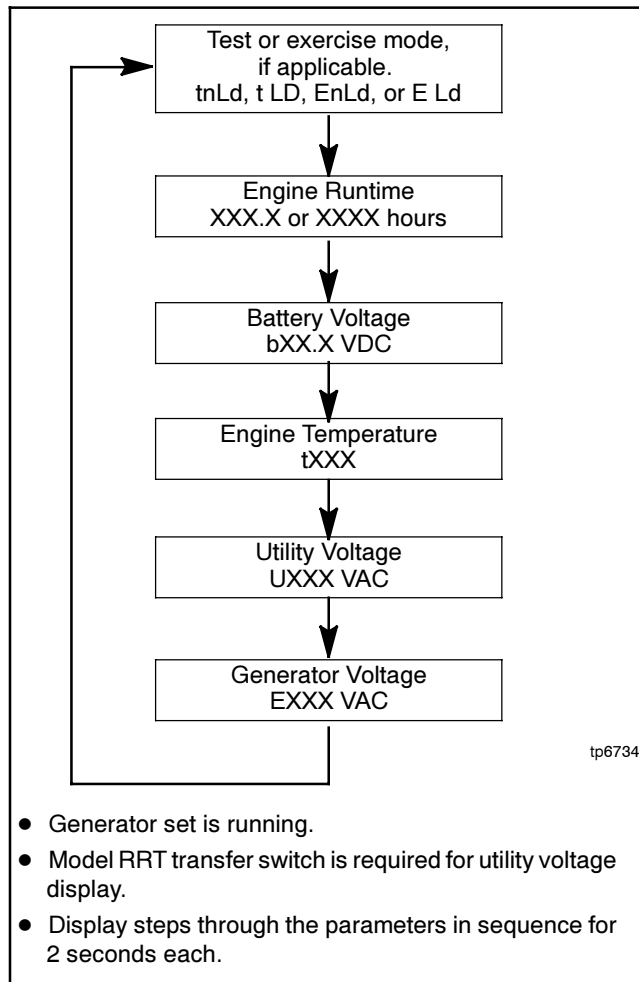


Figure 2-2 Data Displays, Generator Running

Display	Description
Blank (dark)	Controller is off.
u#.#	Controller software version number
XXX.X	Engine hours to 999.9
XXXX	Engine hours, 1000 to 9999
bXX.X	Battery voltage
tXX.X	Engine temperature
UXXX	Utility voltage
EXXX	Generator voltage
tnLd	Test, no load
t Ld	Test, loaded
EnLd	Exercise, no load
E Ld	Exercise, loaded
CC1, 2, or 3	Engine crank cycle 1, 2, or 3. Flashes during crank pause.
Fault code	Warning or fault. See Figure 2-7.

Figure 2-3 RDC Controller Display

2.5.2 Controller Keypad

The Run, Off, Auto, and Down arrow or Exercise buttons control the generator set as described in Figure 2-4. See Section 2.6 for operation instructions.

RDC controller only: The Select, Up, and Down buttons on the controller keypad are used to adjust the controller parameters. The system configuration and performance is factory-set and should not require changes under normal operating conditions. To prevent inadvertent changes, a pass code is required to access the controller parameter settings. Contact an authorized distributor/dealer or service technician if adjustments are required.

Button	Button Function
RUN	Starts the generator set. The engine start time delay is ignored.
OFF	Shuts down the generator set. The cooldown time delay is ignored. During the engine crank cycle, pressing OFF will stop the crank cycle. Press and hold for 3 seconds to view event history. See Section 2.11.
AUTO	Places the generator set in Auto mode. See Figure 2-5.
DOWN arrow (RDC) or EXERCISE (DC)	Starts an unloaded exercise. Press during test or exercise to change from unloaded to loaded.
Select	RDC only. Used to change parameter settings. Password-protected. Contact your distributor/dealer if necessary.
UP arrow	

Figure 2-4 Pushbutton Operation

Mode	LED Indication	Description
RUN	RUN LED is on	The generator set was started by pressing the RUN button. Generator set is running. Remote start and stop commands are ignored.
OFF	OFF LED lights for 2 seconds, then flashes every 2 seconds.	The OFF button was pressed. Generator set and controller are off. Remote start/stop commands have no effect.
AUTO	AUTO LED is on	Automatic mode. Generator set will respond to engine start and stop commands from the controller or an ATS. Time delays operate as described in Section 2.6.

Figure 2-5 Operation Modes and LED Indicators

2.5.3 LED Indicators

LEDs above the RUN, OFF, and AUTO buttons indicate the mode of operation as shown in Figure 2-5.

2.6 Generator Set Operation

2.6.1 Engine Start Crank Cycle

The controller attempts to start the generator set three times (three crank cycles, 15 seconds crank and 15 seconds off). See Figure 2-3 for display information during the crank cycle. If the generator set does not start in three attempts, the system shuts down on an overcrank fault. See Section 2.9.

Pressing the OFF button during the crank cycle stops the cranking. No other buttons are acknowledged during the crank cycle.

2.6.2 Local Starting and Stopping

Start

Press the RUN button to immediately start the generator set. The engine start time delay will be ignored.

The controller attempts to start the generator set three times. If the generator set does not start in three attempts, the system shuts down on an overcrank fault. See Section 2.9.

Stop

1. Run the generator set with no load for at least 2 minutes to ensure adequate engine cooldown.
2. Press the OFF button. The engine stops.

2.6.3 Automatic Operation with Model RRT Transfer Switch

The model RRT transfer switch connects to the RDC/DC controller through the ATS interface board on the transfer switch. Also see Section 2.10, Model RRT Transfer Switch Operation.

The controller must be in AUTO mode. Press the AUTO button to put the controller into automatic mode.

Automatic Start

The RDC/DC controller receives utility source voltage sensing data from the model RRT transfer switch.

1. If the utility source voltage falls below an acceptable level, the controller starts the engine start time delay.
2. If the utility source is not restored before the time delay expires, the generator set starts.

3. After the Normal-to-Emergency time delay, the ATS is signaled to transfer the load to the emergency source.

Automatic Stop with Engine Cooldown

1. When the utility source is restored, the Emergency-to-Normal time delay starts.
2. When the Emergency-to-Normal time delay expires, the load is transferred to the utility.
3. The controller runs the generator set for the cooldown time and then stops the generator set.

2.6.4 Automatic Operation with Model RDT or RSB Transfer Switches

If a Kohler Model RDT or RSB transfer switch is used, the engine start contacts from the ATS must be connected to engine start leads 3 and 4 on the generator set.

The controller must be in AUTO mode to respond to remote start/stop signals from an ATS or remote switch. Press the AUTO button to put the controller into automatic mode.

Automatic Start

The engine start contacts on the ATS close to signal the generator set to start, and remain closed while the generator set is running.

Automatic Stop

Open the contact across engine start leads 3 and 4 to signal the generator set to stop.

2.7 Exercise

A power system that includes a model RES or RESL generator set and a model RRT transfer switch can be set to automatically run the generator set at the same time and day each week. Exercising the generator set weekly is required in order to keep the engine and alternator in good operating condition.

Follow the instructions in this section to start a 20-minute exercise run and set the exerciser to run at the same time every 7 days.

Note: These instructions apply to systems that have a Kohler® model RRT transfer switch connected to the RDC/DC controller.

If a model RDT or RSB transfer switch is used with the generator set, refer to the instructions provided with the transfer switch to set the exerciser.

2.7.1 Unloaded Exercise with Diagnostic Test

An unloaded exercise runs the generator set without signalling the transfer switch to transfer the electrical load from the utility source to the generator set. To start an unloaded, ultra-quiet diagnostic test, the control must be in the AUTO mode with the AUTO LED ON and the Utility power available.

1. Press the down arrow button (RDC) or exercise button (DC) to initiate the engine start signal.
2. The generator begins its crank cycles. During the crank cycles **CCn** appears on the display. No button presses are acknowledged during the crank cycles.
3. **EnLd** appears on the display once the generator is running. The generator runs at low speed. The AUTO LED will be illuminated. The controller monitors the system during the unloaded exercise as described in Section 2.7.2, Low Speed Diagnostics.
4. The generator runs at low speed for 20 minutes and then shuts down.

Note: If the engine temperature has risen to 104°C (219°F) or higher, the unit will run at full speed for 5 minutes to allow engine cooldown before shutting down.

The exercise time is set to the time the down arrow or exercise button was pressed. An unloaded, ultra-quiet diagnostic test will occur at the same time every seven days.

2.7.2 Low-Speed Diagnostics

During the unloaded diagnostic test, the controller monitors the following data. The controller display indicates an unloaded exercise run (EnLd) during the diagnostics, unless a fault is detected as described below.

- **Battery voltage.** If the controller detects low battery voltage, a low battery warning is indicated and the exercise does not start.
- **Generator output frequency and voltage.** The controller verifies that the voltage and frequency are within acceptable limits for the run speed.
- **ATS connection.** The controller verifies that the ATS interface board, if connected, remains connected. An ATS Communication Lost fault will be displayed if the connection is lost.
- **Oil pressure.** The controller verifies the engine oil pressure during low speed operation.

2.7.3 Loaded Exercise

A loaded test or exercise starts the generator set and then transfers the electrical load from the utility source to the generator set. The load is transferred back to the utility source before the generator set shuts down.

To start a loaded full-speed exercise, the control must be in the AUTO mode with the AUTO LED on and utility power must be available.

1. Press the down arrow button (RDC) or the exercise button (DC) to initiate the engine start signal.
2. The generator begins its crank cycles. During the crank cycles **CCn** appears on the display. No button presses are acknowledged during the crank cycles.
3. **EnLd** appears on the display once the generator is running. The AUTO LED will be illuminated. The generator is running at low speed with no load.
4. Press the down arrow button (RDC) or exercise button (DC) a second time. The generator ramps up to normal operating speed (typically 3600 RPM) and the ATS transfers the load.
5. **E Ld** appears on the display. The AUTO LED is illuminated. The generator runs at normal operating speed for twenty minutes with load.

- After 20 minutes, the ATS transfers the load back to utility power. The engine runs for the cooldown cycle and then shuts down.

The exercise time is set to the time the down arrow button (RDC) or exercise button (DC) was initially pressed. A loaded, full-speed exercise will occur at the same time every seven days.

2.7.4 Exerciser Reset and Disable

To reset the exerciser to run at a different day and/or time, or to switch between a loaded and unloaded exercise, follow the procedures above to start an unloaded or loaded exercise on the desired time and day. The previous exercise setting is replaced by the new time, day, and loaded or unloaded condition.

To disable the exerciser, press and hold the OFF and DOWN arrow or EXERCISE buttons together for 3 seconds.

2.7.5 Power Failure During Exercise Cycle

If the utility power is lost during an unloaded exercise, the ATS transfers to the emergency source, the exercise is ended and the control remains in the AUTO mode.

If the utility power is lost during a loaded exercise, the exercise is ended. The ATS remains in the emergency position and the control goes into the AUTO mode.

When Utility power is restored, the ATS will re-transfer to the utility source through normal timing sequences.

2.8 Test

An operator can use the buttons on the RDC/DC controller to test the generator set and transfer switch (model RRT only) operation at any time. Unlike the exercise function, a test does not start or stop automatically. The operator must use the RDC/DC controller to start and stop the test. Follow the instructions below to run an unloaded or loaded test.

2.8.1 Unloaded Test

An unloaded test runs the generator set without signalling the transfer switch to transfer the electrical load from the utility source to the generator set.

Press the RUN button to start an unloaded test. The engine cranks and starts. **tnLd** appears on the display once the generator is running. The RUN LED is

illuminated. The engine runs at normal operating speed (3600 RPM) during the test sequence.

Pressing the OFF button during the crank cycle stops the cranking. No other buttons are acknowledged during the crank cycle.

There are two ways to end an unloaded test:

- Press the AUTO button to shut down the generator set and enter AUTO mode.
- Press the OFF button to shut down the generator set. The cooldown time delay is ignored.

Figure 2-6 describes the effect of pressing the buttons during a test, with the engine running and no active faults.

Button Press	Response
AUTO	Shuts down the engine, through normal timing sequences, and goes to the AUTO mode. AUTO LED turns ON. RUN LED turns OFF.
OFF	Ends the test and shuts down the generator. The cooldown time delay is ignored when a test is ended. The RUN LED turns OFF. The OFF LED turns ON and then flashes every 2 seconds.
RUN	No effect.
DOWN arrow/ EXERCISE	Causes the ATS to transfer to the emergency source. The display indicates a Loaded Test, t Ld .

Figure 2-6 Button Function During Test

2.8.2 Loaded Test

A loaded test starts the generator set and then signals the model RRT transfer switch to transfer the electrical load from the utility source to the generator set. The load is transferred back to the utility source before the generator set shuts down.

To run a loaded test:

- Press the RUN button to start an unloaded test as described in Section 2.8.1. **tnLd** appears on the display once the generator is running.
- Press the down arrow button (RDC) or the exercise button (DC) to signal the ATS to transfer the load. The display indicates a loaded test, **t Ld**.
- To end the test, press the AUTO button to shut down the generator set through normal timing sequences. The engine cooldown cycle runs

before the generator set engine stops. The generator set goes into Auto mode.

Immediate Shutdown During a Loaded Test

Press the OFF button to shut the generator set down immediately, if necessary. The cooldown time delay is ignored, and the controller goes to OFF mode. The controller signals the RRT transfer switch to transfer the load back to utility power.

Note: Running the generator set with no load for at least 2 minutes is recommended to ensure adequate engine cooldown. Use the OFF button to stop a loaded test only if necessary.

2.8.3 Power Failure During Test Cycle

If the utility power is lost during an unloaded test, the ATS transfers to the emergency source and the test is ended. The control goes into the AUTO mode.

If the utility power is lost during a loaded test, the test is ended and the ATS remains in the emergency position. The control goes into the AUTO mode.

When Utility power is restored, the ATS re-transfers to the utility source through normal timing sequences.

2.9 Faults

Fault conditions are shown in Figure 2-7. Fault conditions are classified as warnings or shutdowns.

2.9.1 Warnings

The controller displays a fault code but the generator set does not shut down on a warning. The controller resets automatically after a warning condition is corrected.

2.9.2 Shutdowns

Under a fault shutdown condition, the generator set shuts down automatically and the controller displays a fault code. In some cases, the engine cooldown cycle runs before the engine shuts down. See Figure 2-7.

Shutdown switches (such as the low oil pressure switch or high engine temperature switch) on the generator set will automatically reset when the problem is corrected. However, the fault condition at the controller does not clear until the controller is reset.

The generator set cannot be restarted until the fault condition is corrected and the controller is reset. See

Section 2.9.4 to reset the controller after a fault shutdown.

2.9.3 ATS Communication Errors

An ATS fault can be caused by two conditions.

- When a model RRT transfer switch is used, an ATS fault indicates that communication with the interface board on the transfer switch has been lost. The generator set shuts down. Check the connection to the ATS interface board.
- When a model RDT or RSB transfer switch is used, an ATS fault indicates that connection to the ATS interface board is detected when it is not expected. A warning is displayed but the generator set does not shut down.

2.9.4 Resetting the Controller after a Fault Shutdown

Always identify and correct the cause of a fault shutdown before resetting the controller. Check the fault code displayed on the controller and refer to Figure 2-7 to identify and correct the fault condition before proceeding. Contact an authorized distributor/dealer for service, if necessary.

Procedure to Reset the Controller after a Fault Shutdown

1. Press OFF to turn off the generator set.
2. Disconnect the generator set from the load using the line circuit breaker or ATS. See the safety precautions at the beginning of this manual before proceeding.
3. Identify and correct the cause of the fault shutdown. See the safety precautions at the beginning of this manual before proceeding. Refer to Section 4, Troubleshooting.
4. Start the generator set by pressing RUN. Check the generator set operation to verify that the cause of the shutdown has been corrected.
5. Press the OFF button to stop the generator set.
6. Reconnect the generator set to the load using the line circuit breaker or ATS.
7. Press AUTO to put the generator set into automatic mode.

Code	Fault	Warning (W) or Shutdown (SD)	Condition	Check
AF	Auxiliary fault input	SD *	An optional customer-connected input is closed.	Check customer-supplied equipment.
HE	High engine temperature	SD *	Engine coolant temperature exceeds the maximum temperature for more than 5 seconds. Function becomes active after crank disconnect.	Check for blocked air inlets and exhaust outlets.
LOP	Low oil pressure	SD *	The LOP switch indicates low oil pressure for more than 5 seconds. Function becomes active 30 seconds after crank disconnect (30 second inhibit). Note: The low oil pressure shutdown does not protect against low oil level. Check the engine oil level regularly as recommended in Section 3.	Check for leaks in the lubrication system. Check the oil level and add oil if the level is low.
OC	Overcrank	SD	Three unsuccessful starting attempts.	Check the fuel supply, spark plug, and battery.
Lr	Locked rotor	SD	No engine rotation is sensed during cranking. Shuts down 3 seconds after the fault is detected.	Check for loose connections. Contact an authorized distributor/dealer for service.
OF	Overfrequency	SD *	Governed frequency exceeds 110% of the system's frequency setpoint for more than 5 seconds. Function becomes active 10 seconds after engine start (10 second inhibit).	Contact an authorized distributor/dealer for service.
OS	Overspeed	SD *	Engine speed exceeds 115% of the normal running speed for more than 0.3 seconds.	Contact an authorized distributor/dealer for service.
US	Underspeed	SD *	Engine speed drops below 85% of the normal running speed for more than 0.3 seconds.	Reduce the load. Contact an authorized distributor/dealer for service.
OU	Overvoltage	SD *	Output voltage exceeds 120% of the system nominal voltage for more than 2 seconds.	Contact an authorized distributor/dealer for service.
UF	Underfrequency	SD *	Governed frequency falls below 90% of the system frequency setting for more than 5 seconds, or 1 Hz below the system frequency setting for more than 60 seconds. Function becomes active 10 seconds after engine start. (10 second inhibit).	Reduce the load and restart the generator set. Contact an authorized distributor/dealer for service.
UU	Undervoltage	SD *	Output voltage falls below 80% of the nominal system voltage for more than 10 seconds.	Reduce the load and restart the generator set. Contact an authorized distributor/dealer for service.
HB	High battery voltage	W	Engine starting battery voltage rises above 125% of the battery voltage setting for more than 10 seconds when the engine is running. Not operative during the engine crank cycle. Clears when the battery voltage returns to an acceptable level.	Check the battery rating and condition. Check the battery charger operation.

* Engine cooldown runs before shutting down.

(continued on next page)

Code	Fault	Warning (W) or Shutdown (SD)	Condition	Check
LB	Low battery voltage	W	Engine starting battery voltage falls below the battery voltage setting (typically 12 volts) for more than 90 seconds when the engine is not running. Not operative during the engine crank cycle. Clears when the battery voltage returns to an acceptable level.	Check the battery rating and condition. Check the battery charger operation. Charge or replace the battery.
SS	Speed sensor failure	SD	Engine speed sensor has failed.	Contact an authorized distributor/dealer for service.
AC	Loss of AC sensing	W (1 sec.) SD (3 sec.) *	Generator output AC sensing is lost. Starts 10 seconds after crank disconnect. Warning: after 1 second if no output detected after crank disconnect. Fault: after 3 seconds if voltage was present and then lost.	Contact an authorized distributor/dealer for service.
LCB	Low cranking voltage	W	Battery voltage falls below 60% of system battery voltage for more than 6 seconds while the starter is engaged.	Charge or replace the battery.
ATS	ATS communication error	SD (RRT) * W (other ATS)	RRT: Shutdown if ATS interface connection is lost. Other ATS: Warning is displayed if ATS interface board is connected when it is not expected. See Section 2.9.3.	Check connection to model RRT transfer switch interface board.
LrC	Loss of voltage regulator communication	SD *	No communication between controller and voltage regulator.	Contact an authorized distributor/dealer for service.
* Engine cooldown runs before shutting down.				

Figure 2-7 Controller Fault Codes

2.10 Model RRT Transfer Switch Operation

The RDC/DC generator set/transfer switch controller manages automatic transfer switch (ATS) functions when connected to a Kohler® model RRT transfer switch through the ATS interface board.

2.10.1 Source Availability

The Model RRT transfer switch supplies voltage sensing data to the RDC/DC controller through the ATS interface board. If the source voltage falls below the undervoltage dropout setting, the source is considered to have failed. See Figure 2-8.

Item	Setting
Accuracy	± 5%
Undervoltage Dropout	90% of Pickup
Undervoltage Pickup	90% of Nominal

Figure 2-8 Voltage Sensing Parameters

2.10.2 ATS Control Sequence of Operation

See Figure 2-9 for time delay settings.

Preferred Source Fails:

1. The load control contact opens.
2. The engine start time delay times out.

3. The generator set is signaled to start.
4. The generator starts and the emergency source becomes available.
5. The normal-to-emergency time delay times out.
6. The transfer switch transfers to the emergency source.
7. The load control contact time delay times out.
8. The load control contact closes.

Normal Source Returns:

1. The emergency-to-normal time delay times out.
2. The contactor transfers to the normal source.
3. The engine cooldown time delay times out.
4. The generator is signaled to stop.

2.10.3 Time Delays

Time delays are factory-set to the values shown in Figure 2-9. An authorized distributor/dealer can adjust time delays using a personal computer and Kohler® SiteTech™ software.

Time delays described in this section operate only when the controller is connected to a Kohler® model RRT transfer switch.

Time Delay	Setting	Description
Engine Start	3 seconds	Time delay after utility source is lost until the engine start cycle begins. Guards against starting the generator set because of a brief change in the utility source.
Transfer, Normal to Emergency	3 seconds	Time delay after emergency source becomes available until transfer to emergency source.
Transfer, Emergency to Normal	2 minutes	Time delay after the utility source returns until transfer back to normal. Ensures that the utility source is stable before transferring from the emergency source.
Load Control	5 minutes	Allows delayed connection of selected loads to the generator set. Prevents simultaneous starting of large motors after transfer to the emergency source. Recommended for delayed starting of air conditioners.
Engine Cooldown	5 minutes	Runs the engine with no load after transfer from the generator set. Engine stops before the time delay expires if the temperature drops below the cooled-down temperature level, or if the temperature rises during the cooldown cycle.

Figure 2-9 Time Delays

2.10.4 Engine and Transfer Time Delays

The engine start and transfer time delays prevent engine start and load transfer caused by brief variations in the utility power source.

The engine cooldown time delay allows the engine to run after the loads have been removed. The engine stops before the cooldown time delay expires if the temperature drops below the cooled-down temperature level, or if the temperature rises during the cooldown cycle.

2.10.5 Load Control Time Delay

The load control time delay allows delayed starting of large motor loads (such as air conditioners), preventing simultaneous starting of large motors after transfer to the generator set. The load control time delay is fixed at 5 minutes. It is not adjustable.

The load must be connected to the load control output on the interface board of the model RRT transfer switch. See the transfer switch operation and installation manual for connection instructions.

2.11 Event History

The last ten controller faults can be viewed from the controller display when the controller is off. Each event is displayed with the fault code followed by the engine hours at which time the event occurred. During event history viewing, the OFF LED flashes once per second.

Procedure to View Event History

1. Press and hold the OFF button for 3 seconds. The first event appears on the screen. The OFF LED flashes once per second.
2. Press the OFF button to cycle through the engine hours and subsequent events. After cycling through all ten events, the control automatically turns off. The OFF LED flashes once every 2 seconds.

To stop viewing the event history before the last event, press the down arrow or exercise button. The controller will turn off.

Section 3 Scheduled Maintenance

WARNING

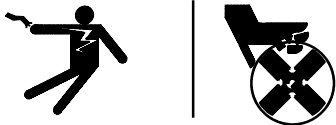


Accidental starting.
Can cause severe injury or death.

Disconnect the battery cables before working on the generator set. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery.

Disabling the generator set. Accidental starting can cause severe injury or death. Before working on the generator set or connected equipment, disable the generator set as follows: (1) Move the generator set master switch to the OFF position. (2) Disconnect the power to the battery charger. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent starting of the generator set by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer.

WARNING



Hazardous voltage. Moving parts.
Can cause severe injury or death.

Operate the generator set only when all guards and electrical enclosures are in place.

WARNING



Hot engine and exhaust system.
Can cause severe injury or death.

Do not work on the generator set until it cools.

Servicing the exhaust system. Hot parts can cause severe injury or death. Do not touch hot engine parts. The engine and exhaust system components become extremely hot during operation.

3.1 Scheduled Maintenance

Refer to the following service schedules and the runtime hours displayed on the controller display to schedule routine maintenance. Intervals are shown in hours of operation and/or time intervals (i.e. weekly, monthly, quarterly, etc.) Have an authorized distributor/dealer service the generator set at the designated intervals in the service schedule for the life of the generator set. Service units subject to extreme weather, long operating hours, or dusty or dirty conditions more frequently.

Contact an authorized distributor/dealer for parts.

3.1.1 Service Schedule, 14RES/RESL Models

System Component or Procedure	See Section	Procedure					Frequency
		Visually Inspect	Check	Change	Clean	Test	
Fuel							
Flexible lines and connections		X		R			Quarterly
Main tank supply level			X				Weekly
Fuel piping		X					Yearly
Lubrication	3.2						
Oil level		X	X				8 hours or before use
Crankcase breather hose		X					Yearly or 500 hours
Change oil				X			Yearly or 100 hours
Replace filter				X			Yearly or 200 hours
Cooling	3.5						
Air ducts, louvers			X		X		Yearly
Exhaust Line	3.6						
Leakage		X	X				Weekly
Insulation, fire hazards		X					Yearly
Obstructions or combustible materials near exhaust outlet		X					Weekly
DC Electrical System	3.7						
Battery charger operation, charge rate (if equipped)		X					Monthly
Remove corrosion, clean and dry battery and rack		X			X		Yearly
Clean and tighten battery terminals and inspect boots		X	X				Yearly
Battery electrolyte level and specific gravity *			X				Yearly
AC Electrical System							
Tighten control and power wiring connections			X				Yearly
Remote control system, if equipped						X	Monthly
Visible wear or damage		X					Quarterly
Wire abrasions where subject to motion		X	X				Six Months
Wire-cable insulation condition		X					3 Years or 500 hours
Engine and Mounting							
Visible wear or damage		X					Weekly
Air cleaner and precleaner service †	3.4			R			Yearly or 100 hours
Spark plugs	3.3			X			Yearly or 300 hours
Replace stepper motor coupling and bushing				D			500 hours
Generator							
Visible wear or damage		X					Quarterly
Exercise generator set						X	Weekly
Brushes and collector ring		D			D		Yearly
Measure and record resistance readings of windings with insulation tester (Megger®, with SCR assembly or rectifier and load leads disconnected) *						D	3 Years
General Condition of Equipment							
Evidence of vibration, leakage, excessive noise, temperature, or deterioration		X	X		X		Weekly
Interior of sound enclosure		X			X		Quarterly
* Not necessary for maintenance-free batteries.		X Action					
† Service more frequently under extremely dusty/dirty conditions.		D Authorized distributor/dealer only					
Megger® is a registered trademark of Biddle Instruments.		R Replace as necessary					

3.1.2 Service Schedule, 20RES/RESL Models

System Component or Procedure	See Section	Procedure					Frequency
		Visually Inspect	Check	Change	Clean	Test	
Fuel							
Flexible lines and connections		X		R			Quarterly
Main tank supply level			X				Weekly
Fuel piping		X					Yearly
Lubrication	3.2						
Oil level			X				8 hours or before each use
Change oil				X			Yearly or 150 hours
Replace filter				X			Yearly or 150 hours
Crankcase breather hose		X					Yearly or 500 hours
Oil cooler		X			X		Yearly or 100 hours
Cooling	3.5						
Air ducts, louvers			X		X		Yearly
Exhaust System	3.6						
Leakage		X	X				Weekly
Insulation, fire hazards		X					Yearly
Obstructions or combustible materials near exhaust outlet		X					Weekly
DC Electrical System	3.7						
Battery charger operation, charge rate		X					Monthly
Remove corrosion, clean and dry battery and rack		X			X		Yearly
Clean and tighten battery terminals and inspect boots		X	X				Yearly
Battery electrolyte level and specific gravity *			X				Yearly
AC Electrical System							
Tighten control and power wiring connections			X				Yearly
Remote control system, if equipped						X	Monthly
Visible wear or damage		X					Quarterly
Wire abrasions where subject to motion		X	X				Six Months
Wire-cable insulation condition		X					3 Years or 500 hours
Engine and Mounting							
Visible wear or damage		X					Weekly
Air cleaner service †	3.4		150	300			Yearly or hours shown
Spark plugs	3.3		150	300			Yearly or hours shown
Replace stepper motor coupling and bushing				D			500 hours
Generator							
Visible wear or damage		X					Quarterly
Exercise generator set						W	Weekly
Brushes and collector ring		D			D		Yearly
Measure and record resistance readings of windings with insulation tester (Megger®, with SCR assembly or rectifier and load leads disconnected)						D	3 Years
General Condition of Equipment							
Evidence of vibration, leakage, deterioration, unusual or excessive noise or temperature		X	X		X		Weekly
Interior of sound enclosure		X			X		Quarterly
* Not necessary for maintenance-free batteries.			X	Action			
† Service more frequently under extremely dusty/dirty conditions.			D	Authorized distributor/dealer only			
Megger® is a registered trademark of Biddle Instruments.			R	Replace as necessary			

3.2 Lubrication System

See the service schedules in Section 3.1 for oil change and oil filter replacement intervals. See the service views in Section 1.7 for the oil drain, oil check, oil fill, and oil filter locations.

3.2.1 Low Oil Pressure Shutdown

The low oil pressure (LOP) shutdown feature protects the engine against internal damage if the oil pressure drops below a minimum pressure because of oil pump failure or other malfunction.

Note: The LOP shutdown feature does not protect against damage caused by operating when the oil level is low; it is not a low oil level shutdown. Check the oil level regularly, and add oil as needed.

3.2.2 Oil Check

The generator set is shipped with oil. Before operating the generator set, check the engine oil in the crankcase. See Figure 3-1.

Maintain the oil level at or near, not over, the full mark on the dipstick. Add 5W-30 synthetic oil when the oil level is low.

Check the oil level before each use. For extended operation, check the oil level every 8 hours. Do not check the oil level when the generator set is running. Shut down the generator set and wait several minutes before checking the oil.

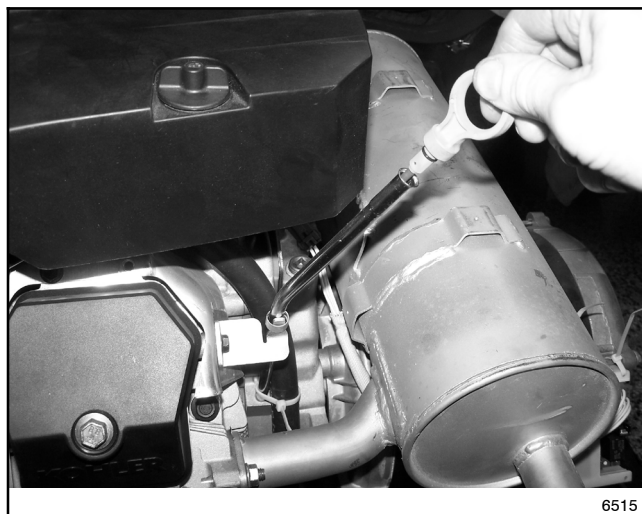


Figure 3-1 Oil Check (typical)

3.2.3 Engine Oil Recommendation

Use 5W-30 API (American Petroleum Institute) Service Class SG, SH, or SJ synthetic oil. Synthetic oil oxidizes and thickens less than other oils and leaves the engine intake valves and pistons cleaner.

3.2.4 Oil Change Procedure

Note: Dispose of all waste materials (engine oil, fuel, filter, etc.) in an environmentally safe manner.

Drain the oil while it is still warm.

1. Drain the oil.

- a. Press the OFF button on the generator set controller.
- b. Disconnect the power to the battery charger.
- c. Disconnect the generator set engine starting battery, negative (-) lead first.
- d. Remove the housing side panel.
- e. Clean the area around the dipstick and oil fill cap.
- f. Remove the oil drain hose from its retaining clip. Remove the cap from the oil drain hose and lower the hose into an oil collection container.
- g. Open the oil drain valve on the engine.
- h. Remove the dipstick and oil fill cap. Allow time for the engine oil to drain completely.
- i. Close the oil drain valve. Replace the cap on the oil drain hose. Replace the oil drain hose in its retaining clip.
- j. Replace the dipstick.

2. Replace the oil filter.

- a. Clean the area around the oil filter. Remove the oil filter by rotating it counterclockwise with an oil filter wrench.
- b. Clean the gasket sealing surface of the oil filter adapter.
- c. Apply a light coat of clean oil to the rubber seal of the new oil filter.
- d. Install the new oil filter following the instructions provided with the filter.

3. Fill with oil.

- a. Fill the engine to the F mark on the dipstick. The engine oil capacity is shown in Figure 3-2. See Section 3.2.3, Engine Oil Recommendation, for oil selection.

Generator Set Model	Oil Capacity, L (qt.)
14RES/RESL	1.9 (2.0)
20RES/RESL	2.8 (3.0)

Figure 3-2 Engine Oil Capacity

- b. Reinstall the dipstick and the oil fill cap.
- c. Check that the generator set master switch is in the OFF position.
- d. Reconnect the generator set engine starting battery, negative (-) lead last.
- e. Reconnect the power to the battery charger.
- f. Start and run the generator set for a minute to allow the oil pressure to reach operating range.
- g. Stop the generator set, wait 1 minute, and then recheck the oil level. Add oil to bring the level up to the F mark on the dipstick.

4. Check for leaks.

- a. Check for oil leaks.
- b. Fix leaks and recheck the oil level.
- c. Reinstall the housing side panel.

3.2.5 Oil Cooler 20RES/RESL

Inspect and clean the oil cooler at the intervals indicated in the service schedule. The oil cooler must be kept free of debris.

See Figure 3-3 for the oil cooler location. The oil cooler is located under the No. 2 cylinder shroud. Remove the top mounting screw and loosen the two side screws, then lift off the cylinder shroud.

Clean the outside of the oil cooler fins with a brush or with compressed air.

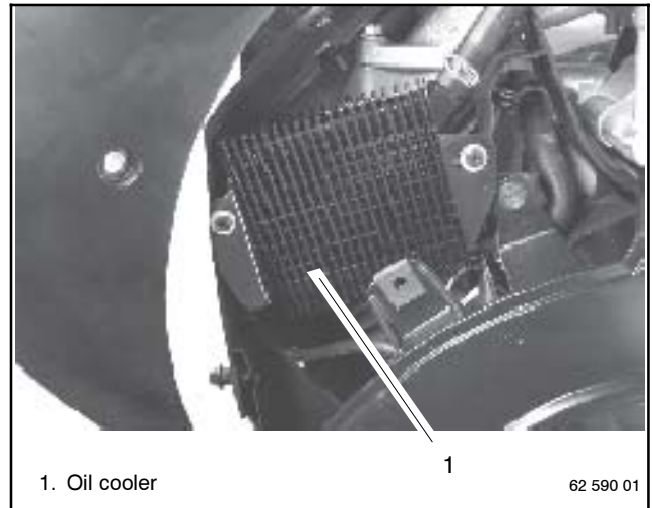


Figure 3-3 Oil Cooler Location

3.3 Spark Plugs

Reset the spark plug gap or replace the plugs with new plugs as necessary.

1. Clean the area around the base of the spark plug to keep dirt and debris out of the engine.
2. Remove the spark plug and check its condition. Replace the spark plug if it is worn or if its reuse is questionable.
3. Check the spark plug gap using a wire feeler gauge. See Figure 3-4 for the recommended spark plug gap. Adjust the gap by carefully bending the ground electrode. See Figure 3-5 and Figure 3-6.
4. Reinstall the spark plug into the cylinder head. Torque the spark plug to 24.4–29.8 Nm (18–22 ft. lb.)

Generator Set Model	Spark Plug Gap
14/20RES/RESL	0.76 mm (0.030 in.)

Figure 3-4 Spark Plug Gap

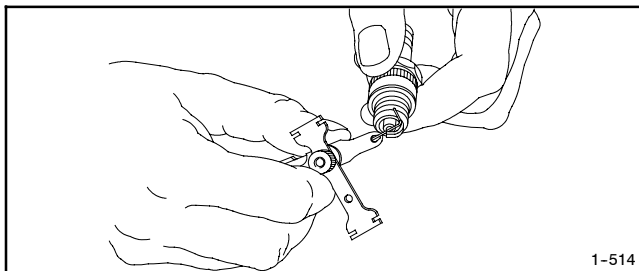


Figure 3-5 Checking the Spark Plug Gap

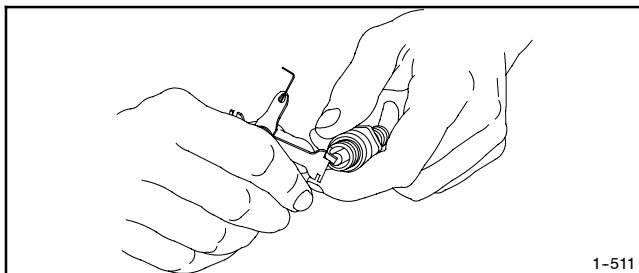


Figure 3-6 Adjusting the Spark Plug Gap

3.4 Air Cleaner Service

3.4.1 Air Cleaner, 14RES/RESL Models

The engine has a replaceable high-density paper air cleaner element with an oiled foam precleaner. See Figure 3-7.

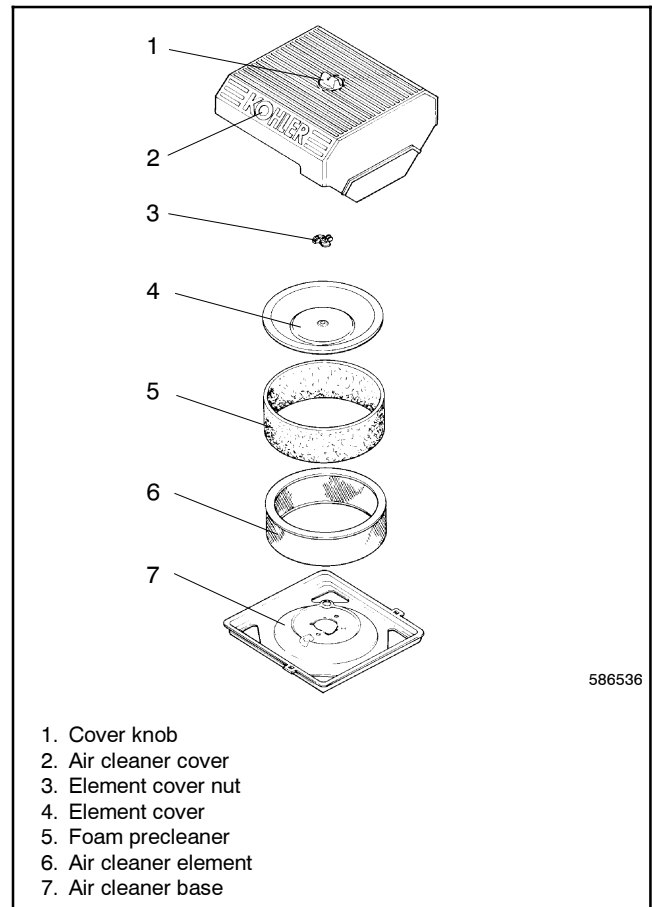


Figure 3-7 Air Cleaner Components

Check for a buildup of dirt and debris around the air cleaner system. Keep this area clean. Also check for loose or damaged components. Replace all bent or damaged air cleaner components.

Note: Operating the engine with loose or damaged air cleaner components could allow unfiltered air into the engine causing premature wear and failure.

Precleaner Service

Use the following procedure to wash and reoil the precleaner as indicated in the service schedule. Wash and reoil the precleaner more often under extremely dusty or dirty conditions.

1. Press the OFF button on the generator set controller.

2. Disconnect the power to the battery charger.
3. Disconnect the battery, negative (-) lead first.
4. Loosen the cover retaining knob and remove the cover. Remove the precleaner from the paper element. Wash the precleaner in warm water with detergent. Rinse the precleaner thoroughly until all traces of detergent are eliminated. Squeeze out excess water (do not wring). Allow the precleaner to air dry.
5. Saturate the precleaner with new engine oil. Squeeze out all of the excess oil.
6. Reinstall the precleaner over the paper element.
7. Reinstall the air cleaner cover. Secure the cover with the cover retaining knob.
8. Reconnect the power to the battery charger.
9. Reconnect the generator set engine starting battery, negative (-) lead last.

Paper Element Service

Use the following procedure to replace the paper element at the intervals specified in the service schedule. Replace the paper element more often under extremely dusty or dirty conditions.

1. Press the OFF button on the generator set controller.
2. Disconnect the power to the battery charger.
3. Disconnect the generator set engine starting battery, negative (-) lead first.
4. Loosen the cover retaining knob and remove the cover.
5. Remove the element cover nut, element cover, and the paper element with precleaner.
6. Remove the precleaner from the paper element.

Note: Do not wash the paper element or clean it with pressurized air, as this will damage the element.
7. Replace the element if it is dirty, bent, or damaged.
8. Check the air cleaner base. Make sure it is secure and not bent or damaged. Also check the element cover for damage and fit. Replace all damaged air cleaner components. Remove any loose dirt or debris from the air cleaner base. Wipe the base carefully so that no dirt drops into the intake throat.

Check the condition of the rubber seal on the air cleaner stud and replace the seal if necessary.

9. Reinstall the paper element, precleaner, element cover, element cover nut, and the air cleaner cover. Secure the cover with the cover retaining knob.
10. Reconnect the power to the battery charger.
11. Reconnect the generator set engine starting battery, negative (-) lead last.

3.4.2 Air Cleaner, 20RES/RESL Models

The engine is equipped with a replaceable, high density paper air cleaner element. See Figure 3-8.

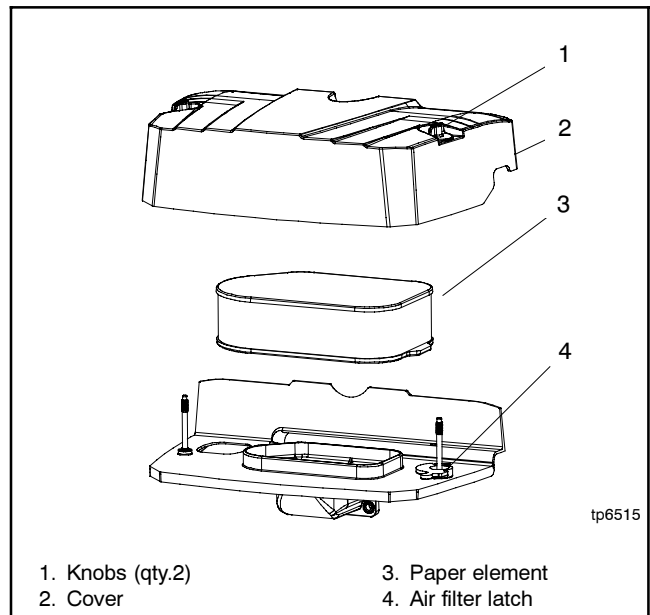


Figure 3-8 Air Cleaner Components

Check the air cleaner daily or before starting the engine. Check for a buildup of dirt and debris around the air cleaner system. Keep this area clean. Also check for loose or damaged components. Replace all bent or damaged air cleaner components.

Note: Operating the engine with loose or damaged air cleaner components could allow unfiltered air into the engine causing premature wear and failure.

Paper Element Service

Replace the paper element at the intervals indicated in the service schedule. See Section 3.1.2 for the service schedule. See Figure 3-8 for the air cleaner components.

1. Loosen the two cover retaining knobs and remove the cover.
2. Rotate the air filter latch counterclockwise to unlock, then remove the paper element.
3. Do not wash the paper element or use pressurized air, as this will damage the element. Replace a dirty, bent, or damaged element. Handle new elements carefully; do not use if the sealing surfaces are bent or damaged.
4. When servicing the air cleaner, check the air cleaner base and latch. Make sure it is secured and not bent or damaged. Also, check the element cover for damage or improper fit. Replace all damaged air cleaner components.

Note: If any loose dirt or debris fell on the air cleaner base when the element was removed, carefully remove it and wipe the base clean. Be careful that none of it drops into the intake throat.

5. Reinstall the paper element onto the air cleaner base. Make sure the element is flat and properly seated. Rotate the latch clockwise, over the molded lip on the element.
6. Install the air cleaner cover and secure with the two retaining knobs.
7. When element replacement is necessary, order genuine Kohler parts.

3.5 Cooling System

The engine fan draws cooling air through the openings in the sides and end near the battery. The alternator fan draws cooling air through openings on the side walls of the enclosure. The cooling air mixes with the engine exhaust and is discharged at the exhaust outlet. See Figure 1-2, Service View, for air intake and exhaust locations. To prevent generator set damage caused by overheating, keep the housing cooling inlets and outlets clean and unobstructed at all times.

Note: Do not block the generator set cooling air inlets or mount other equipment above them. Overheating and severe generator damage may occur.

3.6 Exhaust System

Remove all combustible materials from the exhaust location. Combustible materials include building materials as well as natural surroundings. Keep dry field grass, foliage, and combustible landscaping material a minimum of 1.5 m (5 ft.) from the exhaust outlet.

Periodically inspect the exhaust system components for cracks, leaks, and corrosion.

- Check for corroded or broken metal parts and replace them as needed.
- Check that the exhaust outlet is clear.

3.7 Battery

WARNING



**Sulfuric acid in batteries.
Can cause severe injury or death.**

Wear protective goggles and clothing. Battery acid may cause blindness and burn skin.

Battery electrolyte is a diluted sulfuric acid. Battery acid can cause severe injury or death. Battery acid can cause blindness and burn skin. Always wear splashproof safety goggles, rubber gloves, and boots when servicing the battery. Do not open a sealed battery or mutilate the battery case. If battery acid splashes in the eyes or on the skin, immediately flush the affected area for 15 minutes with large quantities of clean water. Seek immediate medical aid in the case of eye contact. Never add acid to a battery after placing the battery in service, as this may result in hazardous spattering of battery acid.

Battery acid cleanup. Battery acid can cause severe injury or death. Battery acid is electrically conductive and corrosive. Add 500 g (1 lb.) of bicarbonate of soda (baking soda) to a container with 4 L (1 gal.) of water and mix the neutralizing solution. Pour the neutralizing solution on the spilled battery acid and continue to add the neutralizing solution to the spilled battery acid until all evidence of a chemical reaction (foaming) has ceased. Flush the resulting liquid with water and dry the area.

Battery gases. Explosion can cause severe injury or death. Battery gases can cause an explosion. Do not smoke or permit flames or sparks to occur near a battery at any time, particularly when it is charging. Do not dispose of a battery in a fire. To prevent burns and sparks that could cause an explosion, avoid touching the battery terminals with tools or other metal objects. Remove all jewelry before servicing the equipment. Discharge static electricity from your body before touching batteries by first touching a grounded metal surface away from the battery. To avoid sparks, do not disturb the battery charger connections while the battery is charging. Always turn the battery charger off before disconnecting the battery connections. Ventilate the compartments containing batteries to prevent accumulation of explosive gases.

Battery short circuits. Explosion can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage. Disconnect the battery before generator set installation or maintenance. Remove all jewelry before servicing the equipment. Use tools with insulated handles. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery. Never connect the negative (-) battery cable to the positive (+) connection terminal of the starter solenoid. Do not test the battery condition by shorting the terminals together.

Refer to this section for general battery information and maintenance. Also consult the battery manufacturer's instructions for battery maintenance.

All generator set models use a negative ground with a 12-volt engine electrical system. Consult the generator set nameplate for the engine electrical system voltage. Consult the generator spec sheet for battery capacity recommendations for replacement purposes. Wiring diagrams provide battery connection information. See Figure 3-9 for typical battery connections.

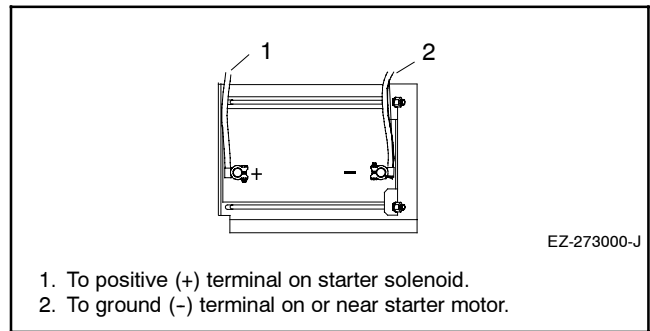


Figure 3-9 12-Volt Engine Electrical System Single Starter Motor, Typical Battery Connection

Clean the battery and cables and tighten battery terminals using the service schedule recommendations. To prevent corrosion, maintain tight, dry electrical connections at the battery terminals. To remove corrosion from battery terminals, disconnect the cables from the battery and scrub the terminals with a wire brush. Clean the battery and cables with a solution of baking soda and water. After cleaning, flush the battery and cables with clean water and wipe them with a dry, lint-free cloth.

After reconnecting the battery cables, coat the battery terminals with petroleum jelly, silicone grease, or other nonconductive grease.

3.8 Battery Charger

The generator set is equipped with a battery charger to maintain the engine starting battery. The charger's DC leads are factory-wired. Periodically check and tighten all connections.

3.8.1 RES Battery Charger

RES model generator sets are equipped with a 6-amp float/equalize battery charger to maintain the engine starting battery. The charger's power cord must be connected to a 120 VAC power source. Figure 3-10 illustrates the battery charger.

The battery charger uses an AGS 10 inline fuse. The fuse is located in the battery lead. See Figure 3-10.

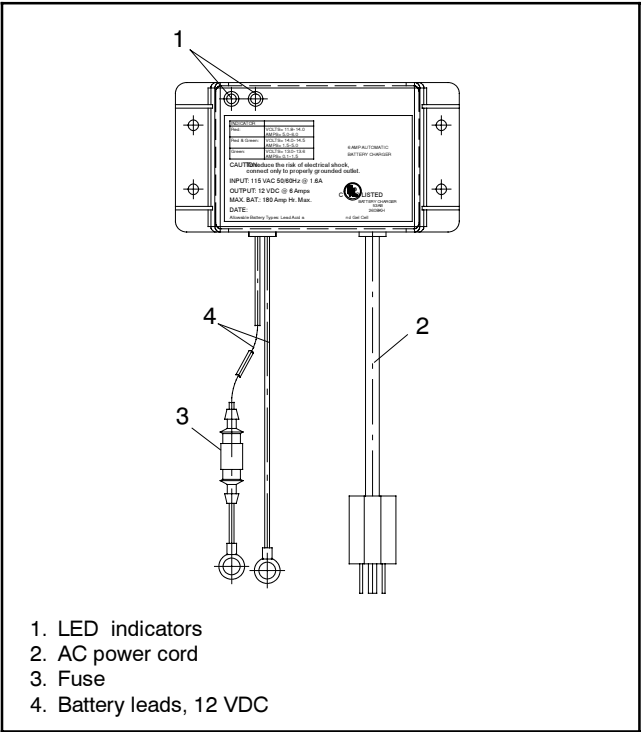


Figure 3-10 6-Amp Float/Equalize Battery Charger

Battery Charger Operation

Figure 3-11 illustrates the three-stage charging method. Red and green LEDs indicate charger operation. The chart in Figure 3-12 describes the LED indicator operation during each stage of the charging process. See Section 4.4 for battery charger troubleshooting information, if necessary.

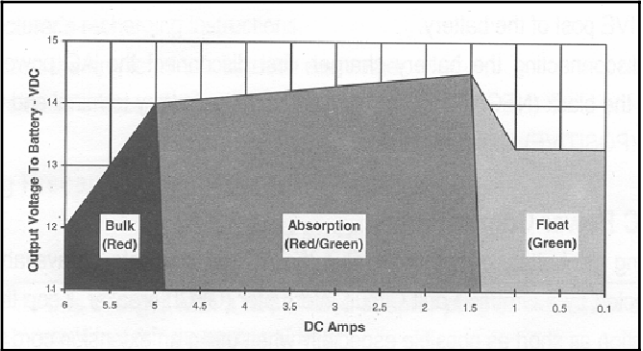


Figure 3-11 Charging Method

Display	Operating Condition
Red ON Green OFF	When the red LED is on, it indicates the battery is discharged and the battery charger is recharging at the BULK rate (stage 1). This charging rate is 6 amps. While the red LED is on, the voltage measured (with the battery charger on) will be 11.8-14 volts. If the red LED stays on for more than 24 hours, refer to Section 4.4 in this manual.
Red ON Green ON	When both the green and the red LEDs are on, the battery charger is charging at an ABSORPTION rate of between 1.5 and 5 amps (stage 2). This mode of charging gradually tops off your battery, and reduces harmful sulfating. While both LEDs are on, the voltage measured (with the battery charger on) should be approximately 14.0-14.5 VDC. If both LEDs stay on longer than 24 hours, refer to Section 4.4 in this manual.
Red OFF Green ON	When the green LED is on, the battery charger is charging at a FLOAT or MAINTENANCE rate of less than 1.5 amps (stage 3). Your battery is now 90% charged and ready for use. This float charging current will gradually decrease to as low as 0.1 amps as the battery reaches 100% charge. It will now be kept at full charge without overcharging. If the green LED stays on when your battery is known to be low, refer to Section 4.4 in this manual.

Figure 3-12 Battery Charger LED Indicator Functions

3.9 Circuit Protection

If the generator set circuit breaker trips or the fuses blow repeatedly, see Section 4, Troubleshooting, for possible causes.

3.9.1 Line Circuit Breaker

A line circuit breaker interrupts the generator output in the event of a fault in the wiring between the generator and the load. The line circuit breaker location is shown in Figure 1-2. If the circuit breaker trips, reduce the load and switch the breaker back to the ON position. With the breaker in the OFF position the generator set runs but the generator output is disconnected from the load.

3.9.2 Fuses

A 20-amp circuit breaker protects the alternator and two fuses protect the electrical controls. See Section 4.2 for fuse locations. A 10-amp inline fuse protects the battery charger.

See Figure 3-13 for fuse part numbers. Always identify and correct the cause of a blown fuse before restarting the generator set. Refer to Section 4, Troubleshooting, for conditions that may indicate a blown fuse. Replace blown fuses with identical replacement parts.

Fuse	Label	Rating, Amp	Part Number
Controller power	F3	3	GM66128
Fuel solenoid/ Starter relay/ Throttle control	F2	7.5	GM66129
Battery charger (RES)	—	10	223316

Figure 3-13 Fuses

3.10 Storage Procedure

Perform the following storage procedure before removing the generator set from service for three months or longer. Follow the engine manufacturer's recommendations for storage, if available.

Note: Run the generator set monthly whenever possible.

3.10.1 Lubricating System

1. Operate the generator set until it reaches operating temperature, or about 15 minutes.
2. Stop the generator set.
3. While the engine is still warm, drain the engine lubrication oil from the engine crankcase.
4. Refill engine crankcase with oil. See Section 3.2.3 for oil recommendations.
5. Run the generator set for a few minutes to distribute the clean oil.
6. Stop the generator set.

3.10.2 Fuel System

1. Start the generator set.
2. With the generator set running, shut off the gas supply.
3. Run the generator set until the engine stops.
4. Press the OFF button on the generator set controller.

3.10.3 Cylinder Lubrication

1. Remove the spark plugs.
2. Pour one tablespoon of engine oil into each spark plug hole. Install the spark plugs and *ground* the spark plug leads. *Do not connect the leads to the plugs.*
3. Crank the engine two or three revolutions to lubricate the cylinders.

3.10.4 Exterior Preparation

1. Clean the exterior surface of the generator set.
2. Seal all openings in the engine with nonabsorbent adhesive tape.
3. Mask all areas to be used for electrical contact.
4. Spread a light film of oil over unpainted metallic surfaces to prevent rust and corrosion.

3.10.5 Battery

Perform battery storage last.

1. Press the OFF button on the generator set controller.
2. Disconnect the battery, negative (-) lead first.
3. Clean the battery.
4. Place the battery in a warm, dry location.
5. Connect the battery to a float/equalize battery charger, or charge the battery monthly using a trickle charger. Follow the battery charger manufacturer's recommendations.

4.1 Introduction

Use the following charts to diagnose and correct common problems. First check for simple causes such as a dead engine starting battery, loose connections, or an open circuit breaker. The charts include a list of common problems, possible causes of the problem, and recommended corrective actions.

If the procedures in this manual do not explain how to correct the problem, contact an authorized distributor/dealer. Maintain a record of repairs and adjustments performed on the equipment. Use the record to help describe the problem and repairs or adjustments made to the equipment.

4.2 Controller Service Access

The controller fuses and alternator winding circuit breaker are accessible from the front of the controller. Remove the service access door to reach the circuit breaker and fuses. See Figure 4-1.

Obtain replacement fuses from a Kohler authorized distributor/dealer.

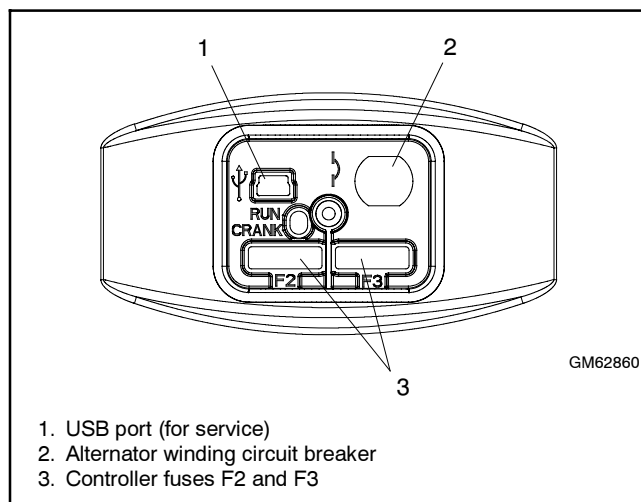


Figure 4-1 Controller Service Access (cover removed)

4.3 Generator Set Troubleshooting

Figure 4-2 contains generator set troubleshooting, diagnostic, and repair information. Check for loose connections before replacing parts.

Fault Codes

The controller displays fault codes to aid in troubleshooting. Fault codes, descriptions, and recommended actions are listed in Section 2.9.

If a fault code is displayed, identify and correct the cause of the fault condition. Then reset the controller. See Section 2.9.4.

Problem	Possible Cause	Corrective Action
Controller LED display is off.	Controller is OFF (check the OFF LED)	Press RUN to start the generator set or AUTO for automatic operation.
	Controller fuse (F3) is blown.	Replace the fuse. If the fuse blows again, contact an authorized distributor/dealer.
	Low or no battery voltage.	Check battery connections. Check the engine starting battery and battery charger. See Figure 4-3.
The generator set does not crank.	Fault shutdown	Check for a fault code on the controller display. See Section 2.9.
	Battery weak or dead	Check power to the battery charger. See Figure 4-3. Recharge or replace the battery.
	Battery charger fuse blown	Replace the fuse. Contact an authorized distributor/dealer for service if fuse blows repeatedly.
	Battery connections reversed or poor	Check battery connections.
	Fuse F2 blown	Replace the fuse. Contact an authorized distributor/dealer for service if fuse blows repeatedly.
	Fuse F3 blown	Replace the fuse. Contact an authorized distributor/dealer for service if fuse blows repeatedly.
	Controller is OFF (check the OFF LED)	Press AUTO for remote start or RUN for local start.
The generator set cranks but does not start, starts hard, lacks power, or operates erratically.	Air cleaner clogged	Clean and/or replace the air cleaner.
	Battery weak or dead	Check power to the battery charger. Recharge or replace the battery.
	Battery connection poor	Clean and tighten the battery connections.
	Spark plug wire connection loose	Check the spark plug wires.
	Low oil pressure shutdown	Check the oil level.
	Fuel pressure insufficient	Check the fuel supply and valves.
	Engine malfunction	Contact an authorized distributor/dealer.
No AC output.	AC circuit breaker in the OFF position	Place the circuit breaker in the ON position.
	AC circuit breaker tripping because of overload	Reduce the load on the generator set.
	AC circuit breaker tripping because of short circuit	Contact an authorized distributor/dealer for service.
	Auxiliary winding circuit breaker tripped	Reset the circuit breaker. See Figure 4-1. Contact an authorized distributor/ dealer for service if circuit breaker trips repeatedly.
Low output or excessive drop in voltage.	Generator set overloaded	Reduce the load.
Generator set stops suddenly.	Low oil pressure shutdown	Check the oil level. Check for signs of oil leaks.
	No fuel	Check fuel supply. Contact fuel supplier.
	Overcrank shutdown	Reset the controller. If the overcrank fault occurs again, contact an authorized distributor/dealer.
	Controller fuse (F3) blown	Replace the fuse. If the fuse blows again, contact an authorized distributor/dealer.
	Overspeed shutdown	Reset the controller. If the overspeed fault occurs again, contact an authorized distributor/dealer.
	Generator set master switch in the OFF/RESET position	Move the switch to the correct position (RUN or AUTO).
	Remote stop command received from a remote switch or ATS	Check the remote switch position.
	Engine malfunction	Contact an authorized distributor/dealer.
	Auxiliary winding circuit breaker tripped	Reset the circuit breaker. See Figure 4-1. Contact an authorized distributor/dealer for service if circuit breaker trips repeatedly.

Figure 4-2 General Troubleshooting Chart

4.4 Battery Charger Troubleshooting

Use the battery charger's LED indicators and the table in Figure 4-3 to troubleshoot battery charger operation problems.

Problem	Cause	Solution
Red LED stays on for more than 24 hours	One or more inoperative or damaged cells.	Load test the battery and replace, if necessary.
	Battery charger has reduced its output voltage below the normal level due to a DC overload or a DC short.	Remove the source of the overload or short. Disconnect the battery charger's black (NEGATIVE) ring terminal from the battery. Reapply AC power and the green LED only should now light.
	Onboard DC systems are drawing more current than the battery charger can replace.	Turn off all DC equipment while charging.
Red and green LEDs stay on for more than 24 hours	Onboard DC systems are drawing between 1.5 and 5 amps.	Turn off all DC equipment while charging.
	One or more inoperative or damaged cells.	Load test the battery and replace, if necessary.
	Extremely low AC voltage at the battery charger.	Apply a higher AC voltage source or reduce the length of the extension cord.
Green LED stays on when the battery is known to be low	Open DC output fuse.	Replace AGS-10 fuse.
	Faulty or contaminated terminal connections.	Clean and tighten or repair all terminal connections.
	One or more inoperative or damaged cells.	Load test the battery and replace, if necessary.
Neither of the LEDs turn on when the AC power is applied	No AC power available at the battery charger.	Connect AC power or reset the AC breaker on the main panel.
	Component failure.	Replace battery charger.

Figure 4-3 6-Amp Battery Charger Troubleshooting

Notes

Appendix A Abbreviations

The following list contains abbreviations that may appear in this publication.

A, amp	ampere	cfm	cubic feet per minute	exh.	exhaust
ABDC	after bottom dead center	CG	center of gravity	ext.	external
AC	alternating current	CID	cubic inch displacement	F	Fahrenheit, female
A/D	analog to digital	CL	centerline	FHM	flat head machine (screw)
ADC	advanced digital control; analog to digital converter	cm	centimeter	fl. oz.	fluid ounce
adj.	adjust, adjustment	CMOS	complementary metal oxide substrate (semiconductor)	flex.	flexible
ADV	advertising dimensional drawing	com	communications (port)	freq.	frequency
Ah	amp-hour	coml	commercial	FS	full scale
AHWT	anticipatory high water temperature	Coml/Rec	Commercial/Recreational	ft.	foot, feet
AISI	American Iron and Steel Institute	conn.	connection	ft. lb.	foot pounds (torque)
ALOP	anticipatory low oil pressure	cont.	continued	ft./min.	feet per minute
alt.	alternator	CPVC	chlorinated polyvinyl chloride	ftp	file transfer protocol
Al	aluminum	crit.	critical	g	gram
ANSI	American National Standards Institute (formerly American Standards Association, ASA)	CSA	Canadian Standards Association	ga.	gauge (meters, wire size)
AO	anticipatory only	CT	current transformer	gal.	gallon
APDC	Air Pollution Control District	Cu	copper	gen.	generator
API	American Petroleum Institute	cUL	Canadian Underwriter's Laboratories	genset	generator set
approx.	approximate, approximately	CUL	Canadian Underwriter's Laboratories	GFI	ground fault interrupter
APU	Auxiliary Power Unit	cu. in.	cubic inch	GND, ⊕	ground
AQMD	Air Quality Management District	cw.	clockwise	gov.	governor
AR	as required, as requested	CWC	city water-cooled	gph	gallons per hour
AS	as supplied, as stated, as suggested	cyl.	cylinder	gpm	gallons per minute
ASE	American Society of Engineers	D/A	digital to analog	gr.	grade, gross
ASME	American Society of Mechanical Engineers	DAC	digital to analog converter	GRD	equipment ground
assy.	assembly	dB	decibel	gr. wt.	gross weight
ASTM	American Society for Testing Materials	dB(A)	decibel (A weighted)	H x W x D	height by width by depth
ATDC	after top dead center	DC	direct current	HC	hex cap
ATS	automatic transfer switch	DCR	direct current resistance	HCHT	high cylinder head temperature
auto.	automatic	deg., °	degree	HD	heavy duty
aux.	auxiliary	dept.	department	HET	high exhaust temp., high engine temp.
avg.	average	dia.	diameter	hex	hexagon
AVR	automatic voltage regulator	DI/EO	dual inlet/end outlet	Hg	mercury (element)
AWG	American Wire Gauge	DIN	Deutsches Institut für Normung e. V. (also Deutsche Industrie Normenausschuss)	HH	hex head
AWM	appliance wiring material	DIP	dual inline package	HHC	hex head cap
bat.	battery	DPDT	double-pole, double-throw	HP	horsepower
BBDC	before bottom dead center	DPST	double-pole, single-throw	hr.	hour
BC	battery charger, battery charging	DS	disconnect switch	HS	heat shrink
BCA	battery charging alternator	DVR	digital voltage regulator	hsg.	housing
BCI	Battery Council International	E ² PROM, EEPROM	electrically-erasable programmable read-only memory	HVAC	heating, ventilation, and air conditioning
BDC	before dead center	E, emer.	emergency (power source)	HWT	high water temperature
BHP	brake horsepower	ECM	electronic control module, engine control module	Hz	hertz (cycles per second)
blk.	black (paint color), block (engine)	EDI	electronic data interchange	IBC	International Building Code
blk. htr.	block heater	EFR	emergency frequency relay	IC	integrated circuit
BMEP	brake mean effective pressure	e.g.	for example (<i>exempli gratia</i>)	ID	inside diameter, identification
bps	bits per second	EG	electronic governor	IEC	International Electrotechnical Commission
br.	brass	EGSA	Electrical Generating Systems Association	IEEE	Institute of Electrical and Electronics Engineers
BTDC	before top dead center	EIA	Electronic Industries Association	IMS	improved motor starting
Btu	British thermal unit	EI/EO	end inlet/end outlet	in.	inch
Btu/min.	British thermal units per minute	EMI	electromagnetic interference	in. H ₂ O	inches of water
C	Celsius, centigrade	emiss.	emission	in. Hg	inches of mercury
cal.	calorie	eng.	engine	in. lb.	inch pounds
CAN	controller area network	EPA	Environmental Protection Agency	Inc.	incorporated
CARB	California Air Resources Board	EPS	emergency power system	ind.	industrial
CAT5	Category 5 (network cable)	ER	emergency relay	int.	internal
CB	circuit breaker	ES	engineering special, engineered special	int./ext.	internal/external
CC	crank cycle	ESD	electrostatic discharge	I/O	input/output
cc	cubic centimeter	est.	estimated	IP	internet protocol
CCA	cold cranking amps	E-Stop	emergency stop	ISO	International Organization for Standardization
ccw.	counterclockwise	etc.	et cetera (and so forth)	J	joule
CEC	Canadian Electrical Code			JIS	Japanese Industry Standard
cert.	certificate, certification, certified			k	kilo (1000)
cfh	cubic feet per hour			K	kelvin
				kA	kiloampere
				KB	kilobyte (2 ¹⁰ bytes)
				KBus	Kohler communication protocol
				kg	kilogram

kg/cm ²	kilograms per square centimeter	NBS	National Bureau of Standards	RTU	remote terminal unit
kgm	kilogram-meter	NC	normally closed	RTV	room temperature vulcanization
kg/m ³	kilograms per cubic meter	NEC	National Electrical Code	RW	read/write
kHz	kilohertz	NEMA	National Electrical Manufacturers Association	SAE	Society of Automotive Engineers
kJ	kilojoule	NFPA	National Fire Protection Association	scfm	standard cubic feet per minute
km	kilometer	Nm	newton meter	SCR	silicon controlled rectifier
kOhm, kΩ	kilo-ohm	NO	normally open	s, sec.	second
kPa	kilopascal	no., nos.	number, numbers	SI	<i>Système international d'unités</i> , International System of Units
kph	kilometers per hour	NPS	National Pipe, Straight	SI/EO	side in/end out
kV	kilovolt	NPSC	National Pipe, Straight-coupling	sil.	silencer
kVA	kilovolt ampere	NPT	National Standard taper pipe thread per general use	SMTP	simple mail transfer protocol
kVAR	kilovolt ampere reactive	NPTF	National Pipe, Taper-Fine	SN	serial number
kW	kilowatt	NR	not required, normal relay	SNMP	simple network management protocol
kWh	kilowatt-hour	ns	nanosecond	SPDT	single-pole, double-throw
kWm	kilowatt mechanical	OC	overcrank	SPST	single-pole, single-throw
kWth	kilowatt-thermal	OD	outside diameter	spec	specification
L	liter	OEM	original equipment manufacturer	specs	specification(s)
LAN	local area network	OF	overfrequency	sq.	square
L x W x H	length by width by height	opt.	option, optional	sq. cm	square centimeter
lb.	pound, pounds	OS	oversize, overspeed	sq. in.	square inch
lbm/ft ³	pounds mass per cubic feet	OSHA	Occupational Safety and Health Administration	SMS	short message service
LCB	line circuit breaker	OV	overvoltage	SS	stainless steel
LCD	liquid crystal display	oz.	ounce	std.	standard
LED	light emitting diode	p., pp.	page, pages	stl.	steel
Lph	liters per hour	PC	personal computer	tach.	tachometer
Lpm	liters per minute	PCB	printed circuit board	TB	terminal block
LOP	low oil pressure	pF	picofarad	TCP	transmission control protocol
LP	liquefied petroleum	PF	power factor	TD	time delay
LPG	liquefied petroleum gas	ph., ∅	phase	TDC	top dead center
LS	left side	PHC	Phillips® head Crimptite® (screw)	TDEC	time delay engine cooldown
L _{wa}	sound power level, A weighted	PHH	Phillips® hex head (screw)	TDEN	time delay emergency to normal
LWL	low water level	PHM	pan head machine (screw)	TDES	time delay engine start
LWT	low water temperature	PLC	programmable logic control	TDNE	time delay normal to emergency
m	meter, milli (1/1000)	PLG	programmable logic control	TDOE	time delay off to emergency
M	mega (10 ⁶ when used with SI units), male	POT	potentiometer, potential	TDON	time delay off to normal
m ³	cubic meter	ppm	parts per million	temp.	temperature
m ³ /hr.	cubic meters per hour	PROM	programmable read-only memory	term.	terminal
m ³ /min.	cubic meters per minute	psi	pounds per square inch	THD	total harmonic distortion
mA	milliampere	psig	pounds per square inch gauge	TIF	telephone influence factor
man.	manual	pt.	pint	tol.	tolerance
max.	maximum	PTC	positive temperature coefficient	turbo.	turbocharger
MB	megabyte (2 ²⁰ bytes)	PTO	power takeoff	typ.	typical (same in multiple locations)
MCCB	molded-case circuit breaker	PVC	polyvinyl chloride	UF	underfrequency
MCM	one thousand circular mils	qt.	quart, quarts	UHF	ultrahigh frequency
Meggar	megohmmeter	qty.	quantity	UIF	user interface
MHz	megahertz	R	replacement (emergency)	UL	Underwriter's Laboratories, Inc.
mi.	mile	rad.	power source	UNC	unified coarse thread (was NC)
mil	one one-thousandth of an inch	RAM	radiator, radius	UNF	unified fine thread (was NF)
min.	minimum, minute	RDO	random access memory	univ.	universal
misc.	miscellaneous	ref.	relay driver output	URL	uniform resource locator (web address)
MJ	megajoule	rem.	reference	US	undersize, underspeed
mJ	millijoule	Res/Coml	remote	UV	ultraviolet, undervoltage
mm	millimeter	RFI	Residential/Commercial radio frequency interference	V	volt
mOhm, mΩ	milliohm	RH	round head	VAC	volts alternating current
MOhm, MΩ	megohm	RHM	round head machine (screw)	VAR	voltampere reactive
MOV	metal oxide varistor	rly.	relay	VDC	volts direct current
MPa	megapascal	rms	root mean square	VFD	vacuum fluorescent display
mpg	miles per gallon	rnd.	round	VGA	video graphics adapter
mph	miles per hour	RO	read only	VHF	very high frequency
MS	military standard	ROM	read only memory	W	watt
ms	millisecond	rot.	rotate, rotating	WCR	withstand and closing rating
m/sec.	meters per second	rpm	revolutions per minute	w/	with
mtg.	mounting	RS	right side	WO	write only
MTU	Motoren-und Turbinen-Union	RTDs	Resistance Temperature Detectors	w/o	without
MW	megawatt			wt.	weight
mW	milliwatt			xfrm	transformer
μF	microfarad				
N, norm.	normal (power source)				
NA	not available, not applicable				
nat. gas	natural gas				

TP-6734 5/10

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